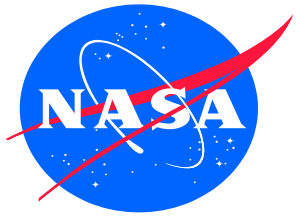


NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FY 02 REVISED FINAL ANNUAL PERFORMANCE PLAN

TABLE OF CONTENTS

FY 2002 REVISED FINAL PERFORMANCE PLAN

NASA FY 2002 Revised Final Performance Plan
Background and Introduction

The Government Performance and Results Act

The Government Performance and Results Act (GPRA) was passed by Congress and signed by the President in 1993. GPRA was enacted to improve the efficiency of all Federal agencies, with the following specific goals:

Improve Federal program management, effectiveness, and public accountability
Improve Congressional decision making on where to commit the Nation's financial and human resources
Improve citizen confidence in Government performance

GPRA directs Executive Branch agencies to develop a customer-focused strategic plan that aligns activities with concrete missions and goals. The Act directs agencies to manage and measure results to justify Congressional appropriations and authorizations. The Report Consolidation Act of 2000 directs agencies to provide a report on the degree of success in achieving the goals and performance measures defined in the strategic and performance plans one hundred and fifty days after the completion of the fiscal year.

NASA's Strategic Management System

Processes within NASA's Strategic Management System provide the information and results for GPRA's planning and reporting requirements. This system is defined in the NASA Strategic Management Handbook (NASA Procedures and Guidelines 1000.2, February 2000). Strategic Management Elements are depicted in the handbook (Figure 1-2) illustrating the hierarchy of documentation for the Strategic Management System (Agency--Enterprise--Centers--Program/Project--Employees).

The NASA Strategic Plan (NASA Policy Directive 1000.1b) defines the vision, mission, and fundamental questions of science and research that provide the foundation of the Agency's goals. The Plan describes five Strategic Enterprises that manage the programs and activities to implement our mission, answer fundamental questions, and provide service to identified customers. These Strategic Enterprises are the: *Space Science Enterprise, Earth Science Enterprise, Human Exploration and Development of Space Enterprise, Biological and Physical Research Enterprise and Aerospace Technology Enterprise*. The support systems for the Strategic Enterprises, defined as Crosscutting Processes, are: *Manage Strategically, Provide Aerospace Products and Capabilities, and Communicate Knowledge.* Interested readers may access NASA's Strategic Plan at the following website:
http://www.hq.nasa.gov/office/codez/new/

The Performance Plan reflects the current Strategic Plan 2000. In the NASA Strategic Plan, the vision and mission statements of the Agency are articulated. We reprint them here for the convenience of the reader.

NASA Vision Statement

NASA is an investment in America's future. As explorers, pioneers, and innovators, we boldly expand frontiers in air and space to inspire and serve America and to benefit the quality of life on Earth.

NASA Mission Statement

- ***To advance and communicate scientific knowledge and understanding of the Earth, the solar system, and the universe;***
- ***To advance human exploration, use, and development of space;***
- ***To research, develop, verify, and transfer advanced aeronautics, space, and space technologies.***

Outcomes of NASA's Activities

Government investment decisions on funding for space and aeronautics research and technology cannot be made knowing in advance the full benefits ("outcomes") that will accrue from making the investments. Nor, can the timetable be known as to when these benefits will be realized. However, we can identify how the outcomes of NASA's activities contribute significantly to the achievement of America's goals in four key areas:

Economic growth and security – NASA conducts aeronautics and space research and develops technology in partnership with industry, academia, and other federal agencies to keep America capable and competitive.

Educational Excellence – NASA involves the educational community in our endeavors to inspire America's students, create learning opportunities, and enlighten inquisitive minds.

Peaceful Exploration and Discovery – NASA explores the Universe to enrich human life by stimulating intellectual curiosity, opening new worlds of opportunity, and uniting nations of the world in this quest.

Preserving the Environment – NASA studies the Earth as a planet and as a system to understand global climate change, enabling the world to address environmental issues.

Performance targets supporting the first three outcomes can be found in all of the Enterprises and Crosscutting Processes. Performance targets supporting the preservation of the environment can be found in the Earth Science Enterprise.

NASA's Fiscal Year 2002 Budget

The NASA FY 2002 budget request supports the President's commitment to support NASA's space and aeronautics program. This budget will support the Agency's priorities as defined in the President's Blueprint for America. It will also support NASA's near – term priorities to fly the Space Shuttle safely and build the International Space Station. NASA's longer-term investments in America's future—developing more affordable, reliable means of access to space and conducting cutting-edge scientific and technological research are also supported.

The successful execution of NASA's strategic goals and objectives is contingent on receipt of the requested appropriations, as well as the provision of funds, materials, or services which have been committed to the cooperative agreements or partnerships that are referenced in this document. The parties to these agreements include: foreign governments, other Federal Agencies or Departments, and commercial entities.

Fiscal Year 2002 Estimates
(In millions of Dollars)

	FY 1999	FY 2000	*FY 2001	FY 2002
NASA Total Budget	**13,653**	**13,602**	**14,253**	**14,902**
SPACE SCIENCE	2,119	2,194	2,321	2,867
EARTH SCIENCE	1,414	1,443	1,485	1,626
HUMAN EXPLORATION AND DEVELOPMENT OF SPACE**	6,123	6,259	6,286	6,830
AEROSPACE TECHNOLOGY	1,339	1,125	1,404	2,508
BIOLOGICAL & PHYSICAL RESEARCH***				820
MISSION SUPPORT/OIG/ACADEMIC PROGRAMS	2,658	2,581	2,757	
OIG/ACADEMIC PROGRAMS				251
CIVIL SERVICE FTEs****	**18,469**	**18,375**	**18,711**	**19,005**

*Reflects 9/28/01 Operating Plan

** Includes Human Space Flight, Biological & Physical Research, Mission Communications and Space Communications Services and Space Operations. Beginning in FY02, the HEDS Enterprise includes Human Space Flight, Space Operations and Safety, Mission Assurance & Engineering.
***Beginning in FY02, Biological & Physical Research is its own Enterprise.
**** FTE's reflect total Agency including Office of Inspector General (OIG).

The mission support line in the preceding table (FY 1999 – 2001) provides funding for mission support and includes: safety, mission assurance, engineering and advanced concepts activities supporting agency program; salaries and related expenses in support of research in NASA field installations; design, repair, rehabilitation and modification of institutional facilities and construction of new

institutional facilities; and other operations activities supporting conduct of agency programs such as the OIG and Academic Programs.

NASA is making progress towards full cost management. Beginning in FY 2002, NASA is implementing a two-appropriation budget (excluding the Inspector General account). The two appropriation budget includes Human Space Flight (HSF) and Science, Aeronautics and Technology (SAT). The budget for Mission Support and other select elements are being allocated against the Enterprises contained in the two appropriation budget starting in FY 2002.

For informational purposes, the Enterprise sections of this plan will display: 1) Enterprise FY funding levels for FY 1999-2002 and, 2) Civil Service staffing levels assigned to each Enterprise.

Additional detail on the means and strategies for accomplishing these performance targets is included in the budget narrative sections of this document. The NASA FY 2002 Budget is also available through the NASA homepage at the following internet address: http://ifmp.nasa.gov/codeb/budget2002/

NASA's Performance Plan

This document, as required by GPRA, describes performance measures and service levels for program activities requested in the FY 2002 budget. FY 2002 Performance goals and objectives are defined for NASA's Strategic Enterprises and for Crosscutting Processes in the *NASA Strategic Plan (NPD 1000.1b).*

NASA has instituted improvements in the FY 2002 Performance Plan. The FY 2002 Plan provides information on how NASA plans to verify and validate performance data. Enterprises/Common Processes also include a description of the individual means that they will use to verify and validate measured values in performance reporting. These added features are provided to communicate various approaches used in the verification and validation of performance data and to support the credibility of reported performance.

Strategic goals and objectives are now provided along with annual performance goals and indicators in the introductory section for each Enterprise and Crosscutting Processes. The annual performance goals and indicators used in performance tracking were integrated with the strategic goals and objectives to provide a better linkage between the Strategic Plan and the Performance Plan. In the FY 2001 Plan, annual performance goals and indicators were provided in separate Enterprise/Crosscutting Process appendix sections. NASA's new format provides greater performance context and eliminates the necessity for a separate performance table to demonstrate the linkage between the Strategic Plan and the Annual Performance Plan that was a duplicative effort.

Generate Knowledge, a common process, is not included in the FY 2002 Performance Plan based on the recommendation of the NASA Advisory Council (NAC). The NAC's recommendation was based on the potential duplication of science research metrics across the Enterprises.

In accordance with OMB Circular A-ll requirements, annual performance goals (APGs) for FY 1999-2002 are displayed by Enterprise/Common Process. Multi-year formats help to demonstrate cumulative progress towards achievement of strategic goals and objectives. Each annual performance goal for FY 1999-2001 has an associated color assessment to facilitate performance trend analysis. Color assessments are established based upon final performance at the end of a fiscal year.

The following color key is used to assess performance:

Blue:	Significantly exceeded performance goal
Green:	Achieved performance goal
Yellow:	Did not achieve performance goal, progress was significant and achievement is anticipated within next fiscal year
Red:	Failed to achieve performance goal, do not anticipate completion within the next fiscal year

Each Enterprise or Common Process section continues to include a budget link table that recaps the relationship of budget account and annual performance goals. To facilitate configuration management, control numbers have been assigned to all annual performance goals. The numbering sequences may not be contiguous, as annual performance goals may have been dropped out as the formulation process progressed.

The Performance Evaluation Process

NASA uses a process of extensive internal and external reviews to evaluate progress against established plans. Enterprises and functional managers conduct reviews on a periodic basis. There are regular reviews for functional management activities, such as procurement, finance, facilities, personnel, information resources management, etc. There are reviews of science, engineering, and technology plans and performance. The NASA Inspector General also conducts independent reviews and provides recommendations for corrective actions.

NASA has established management councils, as described in the NASA Strategic Management Handbook, which conduct internal oversight reviews. Throughout the year, Program Management Councils (PMCs) at Headquarters and the Centers assess program schedules, cost, and technical performance against established programmatic commitments. The Senior Management Council (SMC) brings together both Headquarters and Field Installation Directors to conduct assessment reviews twice a year of the progress being made in meeting the Enterprise and Crosscutting Process performance targets. NASA's management review processes provide appropriate forums for internal reporting and reviewing of project and program performance data. The recent streamlining of agency processes provides confidence that new data collection and oversight processes need not be created for compliance with GPRA. Our mission oriented organizational structure and established management processes are well suited to assessment of this type of performance evaluation.

There are also significant external review processes in place. The external reviews typically begin with the peer review processes in which NASA uses panels of outside scientific experts to ensure that science research proposals are selected strictly on the merits of the planned research. This process takes into account past performance for selection and/or continued funding. NASA requests assistance from other federal agencies to provide expert advice and council. In some cases, the organizations are advisory bodies of experts from the public and private sectors that work with NASA to establish priorities in particular scientific disciplines. For

example, NASA has requested that its senior advisory body, the NASA Advisory Council (NAC), independently review NASA's annual performance. Since FY 1999, the NAC has reviewed reported performance and provided a qualitative assessment of the Agency's progress that is included in the Agency Performance Report. The NAC also reviewed FY 2002 performance metrics providing valuable input for metric development. In other cases, reviews are conducted by organizations such as the Aerospace Safety Advisory Panel, the National Academy of Sciences, and the General Accounting Office, which share responsibility for oversight of the Agency.

The use of these external reviews allows NASA to receive a report card on whether we are making the anticipated progress towards accomplishing the priorities established by the Administration, the Congress, and our advisory bodies. When necessary, these external assessments result in the revision of either implementation plans or strategic plans.

The unique characteristics of research activities, particularly those where the exact timing of findings, discoveries or outcomes cannot be specified in advance, present challenges to research agencies with regards to developing a GPRA outcome goal for a given year. In an effort to provide some measure of performance in light of these challenges, NASA uses indicators as a means to determine progress towards the achievement of annual performance goals in that progress may come through more than one avenue. The number of indicators required for achievement represents a minimum, acceptable level of performance. Associating an acceptable level of achievement (example: 5 out of 6 indicators achieved) or a percentage of total APG indicators can also reflect risk associated with getting full results. This discretion encourages the development of more challenging and meaningful indicators of progress. The Space Science Enterprise (SSE) uses a percentage of total APG indicators accomplished such as 75% to measure the minimum successful achievement of indicators for development in support of science objectives and 66% for technology. Developing new technology carries the most risk, therefore, the achievement of fewer indicators is appropriate. By comparison, the selection of an 80% threshold for operating mission indicators demonstrates that a higher level of achievement is more appropriate as risk diminishes with established programs. Therefore, these percentages are selected dependent upon the level of risk that is appropriate for each type of activity being conducted and an appropriate reflection of the nature of this type of work.

NASA's APGs most often reflect long-term goals while indicators are developed to reflect annual achievement. The discretion of not requiring 100% successful achievement of all indicators when determining annual performance goal achievement better reflects the nature of an inherently unpredictable R&D environment. Progress is the critical factor in ultimate strategic goal achievement.

The GPRA Performance Report Process

For the purposes of the GPRA performance reporting process, NASA uses advisory committees as the critical input when assessing performance. These committees provide inputs on NASA's Strategic Plan, individual Enterprise Strategic Plans, and budgetary priorities. NASA furnishes program performance status information, and in turn, the committees render advice and council. NASA uses this process to generate an independent assessment of annual performance.

NASA has historically been one of the most open federal agencies in terms of performance measurements. Public attention is drawn quickly to program successes, and particularly to program failures. Press conferences on scientific results and program technical status are commonplace. The technical measurement of program progress is a management imperative due to the heavy emphasis on development programs, and within the programs, the specific projects. Flight programs such as the International Space Station compile thousands of technical performance metrics, schedule milestones, and cost performance data.

However, the GPRA requires a heavier focus on outcome metrics rather than NASA's input and output metrics. Like other federal agencies engaged in science and technology, NASA has difficulty in quantifying outcomes and, especially, relating current outcomes to current fiscal expenditures. This is appropriate since NASA's development programs are multi-year in character. In some cases, past expenditures began more than a decade ago. For example, the Hubble Space Telescope that entered into development in the mid-1970's. More recently, NASA has focused on programs and projects with much shorter development periods, on the order of 3-5 years. Yet, the science outcomes are dependent on scientists analyzing the information gathered in the years after launch. Therefore, in measuring the incremental annual performance of a multi-year research or development activity, where an outcome is not realized for several years, output metrics are the most appropriate way to measure the progress towards the achievement of strategic goals and objectives.

The stated objectives of programs within NASA's Enterprises are long-term in character. This is exemplified by considering a Space Science performance objective, "Explore the ultimate limits of gravity and energy in the Universe." Annual performance evaluations assess whether appropriate progress is being made, perhaps actually identifying individual "limits" to the satisfaction of the scientific community, or providing additional insights to the eventual solution of other mysteries. The assessment process requires a multifaceted judgment which takes into account the nature of the challenge of "solving the mystery," the level of resources available to be applied, and the actual scientific achievements of the past year.

It is particularly important in our view to avoid evaluating actual output performance in R&D organizations solely by counting the number of planned events for the year with the number that actually occurred. The "beancount" approach is more appropriate to a known manufacturing environment. In the high-performance, high-risk R&D environment that characterizes NASA's programs, it is inadvisable to incentivize on-time performance and thereby de-emphasize safety, quality, high performance and appropriate risk-taking.

NASA has worked hard to maintain the highest emphasis on safety; this value applies not only to safety of personnel but also to preservation of high value facilities, equipment, experimental hardware, and related capabilities. Quality goes hand-in-hand with safety, but extends well beyond it. For example, taking credit for completing a critical design review (CDR) for a spacecraft is only appropriate when the CDR process has been thorough, complete, and meets performance standards. Great care must be taken that quality does not suffer when contract fee incentives call for a milestone payment upon completion of the CDR. Other examples abound, and give rise to our constant vigilance to avoid rushing to launch in order to achieve a given date.
It is possible, of course, to emphasize safety and quality and achieve little of lasting significance or have the achievement take an inordinate amount of time. Building spacecraft that do not test new designs, but rely only on proven designs, is appropriate for operational, mission agencies or commercial entities. It is not appropriate for NASA's R&D environment. Conducting basic and applied research involves experimentation. When exploring new methods and new technologies in these high-performance

ventures, it is acceptable to take risks, to push the envelope, and to fail. The tolerance of failure puts NASA and other R&D agencies into a different category than other federal agencies involved in the delivery of services to the public. Note, however, that this does not translate into an acceptance of failures that result from taking an inappropriate level of risk. The level of appropriate risk is tailored to the environment. The distinction is critical, particularly in high-value, high-cost environments, such as human space flight, the maintenance of the Hubble Space Telescope, and the launch of research spacecraft. The risk of failure in those venues is limited by all practicable means.

Thus, output measures are best used in suitable context. For these reasons, NASA management encourages Space Shuttle program managers to set aside metrics dealing with launches planned vs. launches achieved during a given fiscal year. If by waiting, one less launch is achieved than planned, but the result is better safety or quality or enables improved performance or reduces risk, then the latter result is what NASA wants to incentivize.

We have met with little success in past efforts to marry conventional output measures to these other parameters to derive a quantitative performance metric. Instead, we have determined that asking independent experts to review both quantitative and qualitative measures and to come up with an integrated score is a better approach.

NASA's Verification and Validation of Performance Data

NASA is committed to ensuring that reported performance information is valid and reliable. Data credibility is a critical element in the Agency's ability to manage for results and to be accountable for the accuracy of performance data. NASA's performance in developing and delivering products and services is evaluated at the Agency, Strategic Enterprise, functional office, program and project, crosscutting process, and individual levels. Each level has responsibility to execute requirements and to measure, evaluate, and report results. Methods and procedures for collecting this information are evaluated and validated by program managers who are responsible for data collection and reporting. As each part of the organization completes its measurement process, data are used to validate that performance meets or exceeds planned goals, objectives and performance targets. In those situations in which performance does not meet expectations, opportunities for continuous improvement are identified.

Communicating our verification and validation approaches provides greater confidence that reported performance information is credible while enhancing the usefulness of the information. In the FY 2001 Performance Report, NASA provided specific documentation of achievement by providing verification and validation methods and data sources for each annual performance goal. Data sources that were used included, but were not limited to, databases used for other purposes, third-party reviews, and certification by managers and/or contractors. Changes or improvements to existing data collection and reporting systems or processes were included in the verification methodology. As appropriate, reliance upon external sources was identified in the data sources section of each target's performance. In the FY 2002 Plan, Enterprises/Crosscutting process identified verification and validation methods that it anticipates will be used to ensure the credibility of reported data.

For the purpose of assessing NASA's overall performance, we will continue to ask our Advisory Committees to evaluate accomplishments at the Enterprise level. Their assessments not only integrate quantitative output measures but also provide balance in the context of safety, quality, high performance, and appropriate risk. The NAC evaluates annual performance for both

the Enterprises and the Common Processes, assessing progress towards strategic goal and objective achievement. In addition, the Office of the Inspector General (OIG) has conducted validation audits of reported performance data used to support the Agency's actual results on selected performance targets to ensure that underlying performance data are accurate and reliable. In their audit of select FY 2000 performance data, the OIG commended NASA for the significant improvement in the reporting of actual performance.

Space Science Enterprise (SSE)

Mission

The primary goal of the Space Science Enterprise is to chart the evolution of the universe from origins to destiny, and improve understanding of galaxies, stars, planets, and life (Figure 2). Within this goal, Enterprise objectives are to: understand the structure of the universe, from its earliest beginnings to its ultimate fate; explore the ultimate limits of gravity and energy in the universe; learn how galaxies, stars and planets form, interact, and evolve; look for signs of life in other planetary systems; understand the formation and evolution of the Solar System and Earth within it; probe the origin and evolution of life on Earth and determine if life exists elsewhere in our Solar System; understand our changing Sun and its effects throughout the Solar System; and chart our destiny in the Solar System. Other Enterprise goals include developing innovative technologies to support Space Science programs and making them available for other applications that benefit the Nation. Enterprise missions and research also yield scientific information of value for future exploration programs. Knowledge and discoveries will be shared with the public to enhance science, mathematics, and technology education and increase the scientific and technological literacy of all Americans.

Implementation Strategy

The Space Science Enterprise Performance Plan is tied directly to the Enterprise Strategic Plan. The Strategic Plan is based on science goals and objectives, with research and flight programs structured to implement these goals. The Enterprise continues to use scientific merit as the primary criterion for program planning and resource commitment. In implementing this program, the Enterprise will preserve safety as NASA's number one priority, with balanced risks between missions to ensure overall achievement of program goals.* Properly implemented, the "faster, better, cheaper" approach does not jeopardize this priority. Projects will not be approved for implementation until a clear technology path to successful implementation is demonstrated. These new technologies will be applied aggressively, within the constraints of prudent stewardship of public investment.

The Enterprise will continue to ensure the active participation of the research community outside NASA in planning, flight programs, research investigations, and peer review; this participation is viewed as being critical to the program's success. Collaborative efforts with other Federal agencies, such as the National Science Foundation, Department of Defense and Department of Energy, as well as with international partners, play a key role in the implementation strategy of the Enterprise. Finally, a fundamental consideration in planning and conducting all of our programs is the recognition that the national investment in space science is a public trust. The Enterprise places a very high priority on sharing the results and excitement of our programs through the formal education system and public engagement.

[*Note: Safety as it applies to human space flight does not apply to Space Science missions and would be prohibitively expensive if it did. Moreover, Space Science missions should not all have the same risk profile. For example, a balance of lower-risk (e.g., Chandra) and higher-risk (e.g., Explorer) missions should be used to maximize science return per dollar.]

Enterprise Resource Requirements

The President has requested the following budget for FY99 to FY02 to support the accomplishment of Space Science goals:

	FY 1999	FY 2000	FY 2001	FY 2002
NOA $M	2119	2,194	2,321	2,867
CS FTEs	1,846	2,362	2,064	2,481

FY 2002 Performance Metrics

Strategic Plan Goal:
Science: **Chart the evolution of the Universe, from origins to destiny, and understand its galaxies, stars, planets, and life.**

Objective: Understand the structure of the Universe, from its earliest beginnings to its ultimate fate.

Public Benefit: One of the great quests of the last half-millennium since the time of Copernicus has been to understand where humanity fits within the Cosmos: What is the age of the Universe? How did it begin and how will it end? What are its primary constituents and how do they interact? NASA's pursuits in the research focus areas are intended to answer these questions.

APG 2S1: Earn external review rating of "green," on average, on making progress in the following research focus areas:

- Identify dark matter and learn how it shapes galaxies and systems of galaxies.
- Determine the size, shape, age, and energy content of the universe.

  Indicators
  - Demonstrate significant progress toward the goal, as determined by external expert review.
  - Obtain expected scientific data from 80% of operating missions supporting this goal (as identified and documented by Associate Administrator at beginning of fiscal year).

Objective: Explore the ultimate limits of gravity and energy in the Universe.

Public Benefit: The basic constituents of Nature interact via fundamental forces that are likely to be studied best by using the Universe as a giant laboratory of extreme environments. Understanding these forces will give us insight into the most important processes in Nature and may reveal "new physics" and new phenomena that cannot be created in any Earthbound laboratory.

APG 2S2: Earn external review rating of "green," on average, on making progress in the following research focus areas:

- Discover the sources of gamma ray bursts and high-energy cosmic rays.
- Test the general theory of relativity near black holes and in the early universe, and search for new physical laws, using the universe as a laboratory.
- Reveal the nature of cosmic jets and relativistic flows.

Indicators

- Demonstrate significant progress toward the goal, as determined by external expert review.
- Obtain expected scientific data from 80% of operating missions supporting this goal (as identified and documented by Associate Administrator at beginning of fiscal year).

Objective: Learn how galaxies, stars, and planets form, interact, and evolve.

Public Benefit: Life on Earth is the product of a complex sequence of events, which are at present only approximately understood. This sequence begins with the birth of the galaxies and continues through the creation of heavy elements inside stars and the birth of stars and other planetary systems. To understand how life arose on Earth, and perhaps elsewhere, a complete understanding of the entire "thread of life" in the Cosmos is necessary.

APG 2S3: Earn external review rating of "green" on average, on making progress in the following research focus areas:

- Observe the formation of galaxies and determine the role of gravity in this process.
- Establish how the evolution of a galaxy and the life cycle of stars influence the chemical composition of material available for making stars, planets, and living organisms.
- Observe the formation of planetary systems and characterize their properties.
- Use the exotic space environments within our Solar System as natural science laboratories and cross the outer boundary of the Solar System to explore the nearby environment of our galaxy.

Indicators

- Demonstrate significant progress toward the goal, as determined by external expert review.
- Obtain expected scientific data from 80% of operating missions supporting this goal (as identified and documented by Associate Administrator at beginning of fiscal year).

Objective: Look for signs of life in other planetary systems.

Public Benefit: "Are we alone?" is one of the most profound questions that humanity can ask, and its answer will affect almost every aspect of how humans view themselves and their place in the Universe.

APG 2S4: Earn external review rating of "green" on average, on making progress in the following research focus areas:

- Discover planetary systems of other stars and their physical characteristics.
- Search for worlds that could or do harbor life.

Indicators

- Demonstrate significant progress toward the goal, as determined by external expert review.
- Obtain expected scientific data from 80% of operating missions supporting this goal (as identified and documented by Associate Administrator at beginning of fiscal year).

Objective: Understand the formation and evolution of the Solar System and the Earth within it.

Public Benefit: Earth and all of the other bodies in the Solar System formed at about the same time from a disk of gas and dust that surrounded the Sun. While these bodies share some similarities, there are striking differences among them. A fundamental goal of the NASA Space Science Enterprise is to understand the physical conditions and processes that led to those

differences. What do these differences imply about the response of Earth's environment to natural and manmade influences? What do they imply about the likelihood of Earth-like planets, potential habitats for life, circling other stars?

APG 2S5: Earn external review rating of "green," on average, on making progress in the following research focus areas:

- Inventory and characterize the remnants of the original material from which the Solar System formed.
- Learn why the planets in our Solar System are so different from each other.
- Learn how the Solar System evolves.

  Indicators
  - Demonstrate significant progress toward the goal, as determined by external expert review.
  - Obtain expected scientific data from 80% of operating missions supporting this goal (as identified and documented by Associate Administrator at beginning of fiscal year).

Objective: Probe the evolution of life on Earth, and determine if life exists elsewhere in our Solar System.

Public Benefit: The organizing principles of life and its origin(s) are very poorly known, but at the same time are essential to understanding the biosphere, the Earth's layer of life. Understanding the origin and early evolution of life on Earth will permit a deeper understanding of the robustness (or fragility) of terrestrial life, life's interactions with the non-living world, and the dangers that life faces in an occasionally hostile environment.

APG 2S6: Earn external review rating of "green," on average, on making progress in the following research focus areas:

- Investigate the origin and early evolution of life on Earth, and explore the limits of life in terrestrial environments that might provide analogues for conditions on other worlds.
- Determine the general principles governing the organization of matter into living systems and the conditions required for the emergence and maintenance of life
- Chart the distribution of life-sustaining environments within our Solar System, and search for evidence of past and present life.
- Identify plausible signatures of life on other worlds.

  Indicators
  - Demonstrate significant progress toward the goal, as determined by external expert review.
  - Obtain expected scientific data from 80% of operating missions supporting this goal (as identified and documented by Associate Administrator at beginning of fiscal year).

Objective: Understand our changing Sun and its effects throughout the Solar System.

Public Benefit: Solar variability affects life and society by causing "space weather," which can affect space assets vital to the national economy (communications, weather, and military satellites), short wave radio communications, the electric power grid, and astronauts. Solar variability also is a natural driver of global climate change, which appears to have affected Earth's climate in the past.

APG 2S7: Earn external review rating of "green," on average, on making progress in the following research focus areas:

- Understand the origins of long- and short-term solar variability.

- Understand the effects of solar variability on the solar atmosphere and heliosphere.
- Understand the space environment of Earth and other planets.

  Indicators
  - Demonstrate significant progress toward the goal, as determined by external expert review.
  - Obtain expected scientific data from 80% of operating missions supporting this goal (as identified and documented by Associate Administrator at beginning of fiscal year).

Objective: Chart our destiny in the Solar System.

Public Benefit: The course of life on Earth has been profoundly altered by impacts of asteroids and/or comets. It is widely accepted that a major impact 65 million years ago led to the extinction of dinosaurs and cleared the way for the rise of mammals. An even greater impact more than 200 million years ago led to the extinction of about 90 percent of the species alive at the time.

Impacts did not end in prehistoric times. In 1908, a fragment of a comet or asteroid leveled hundreds of square miles of forest in the remote Siberian region of Tunguska; had the object fallen about four hours later, it would have annihilated the city of St. Petersburg. It is estimated that there are between 700 and 1000 objects whose orbits cross Earth's (these are known as Near Earth Objects, or NEOs), that are large enough to cause global catastrophe if they were to strike Earth. NASA Space Science supports the search for such NEOs, with a goal of identifying at least 90 percent of them by the year 2008 (nearly 500 have been discovered to date). By identifying those objects that actually have a potential to collide with Earth, we expect to have decades of advance warning in which to take countermeasures, if necessary.

APG 2S8: Earn external review rating of "green," on average, on making progress in the following research focus areas:

- Understand forces and processes, such as impacts, that affect habitability of Earth.
- Develop the capability to predict space weather.
- Find extraterrestrial resources and assess the suitability of Solar System locales for future human exploration.

  Indicators
  - Demonstrate significant progress toward the goal, as determined by external expert review.
  - Obtain expected scientific data from 80% of operating missions supporting this goal (as identified and documented by Associate Administrator at beginning of fiscal year).

Objective: Support of Strategic Plan Science Objectives; Development/ Near-Term Future Investments (Supports all objectives under the Science Goal)

Public Benefit: NASA has been chartered by the American people to undertake challenging scientific explorations of our Solar System and the Universe beyond by building and launching missions that will achieve ambitious scientific goals. Missions in development have moved beyond study and preliminary design, and into detailed design and fabrication. Once launched and operational, the images and data they provide will advance our understanding of our Solar System and the Universe in which we live.

APG 2S9: Earn external review rating of "green" on making progress in the following area:

- Design, develop, and launch projects to support future research in pursuit of Strategic Plan science objectives.
  Indicator
  Meet no fewer than 75% of the development performance objectives for "major programs/projects," supported by completion of performance objectives in majority of "other projects."
  Major Programs/Projects:
  - Hubble Space Telescope (HST) Development: Begin system test of the Cosmic Origins Spectrograph (COS).
  - Hubble Space Telescope (HST) Development: Advanced Camera for Surveys (ACS) and Solar Array 3 (SA3) will be ready for flight and installation on Servicing Mission 3B.
  - Space Infrared Telescope Facility (SIRTF) Development: Complete integration and test (I&T) of spacecraft and payload.
  - Stratospheric Observatory for Infrared Astronomy (SOFIA) Development: Complete installation of the forward pressure bulkhead.
  - Gravity Probe-B (GP-B) Development: Initiate flight vehicle integration and test (I&T).
  - Mars Exploration Rover '03 Development: Initiate assembly, test and launch operations (ATLO) process.
  - Mars Reconnaissance Orbiter '05 Development: Select payload and initiate development.
  - Solar Terrestrial Relations Observatory (STEREO) Development: Have contracts in place for start of spacecraft and instrument detailed design and fabrication.

  Other Projects:
  - Swift Gamma Ray Burst Explorer (Swift) Development: Complete build-up of spacecraft subsystems.
  - Full-sky Astrometric Mapping Explorer (FAME) Development: Conduct Confirmation Review.
  - Galaxy Evolution Explorer (GALEX) Development: Complete environmental testing.
  - Comet Nucleus Tour (CONTOUR) Development: Complete environmental testing.
  - Mercury Surface, Space Environment, Geochemistry and Ranging (MESSENGER) Mission Development: Conduct Critical Design Review (CDR).
  - Solar-B Development: Conduct the Pre-Environmental Review for the U.S.-provided Extreme Ultraviolet Imaging Spectrometer (EIS).
  - Planck Development: Complete the High-Frequency Instrument (HFI) flight detectors.

Strategic Plan Goal:
Technology/Long-Term Future Investments: **Develop new technologies to enable innovative and less expensive research and flight missions.**

Objectives: Acquire new technical approaches and capabilities. Validate new technologies in space. Apply and transfer technology.

Public Benefit: NASA must be a prudent steward of the taxpayers' money by investing in essential technologies that are clearly relevant to future missions. This important principle includes consideration of the possibilities for commercialization, as well as options for using key technologies for multiple missions.

APG 2S10: Earn external review rating of "green" on making progress in the following technology development area:

- Focus technology development on a well-defined set of performance requirements covering the needs of near-term to mid-term strategic plan missions.

  Indicator

  Meet no fewer than 66% of the performance objectives for technology development.
  - Next Generation Space Telescope (NGST): Downselect to single Phase II prime contractor.
  - Space Interferometry Mission (SIM): Use the Microarcsecond Metrology (MAM-1) Testbed to demonstrate metrology at the 200-picometer level with white light fringe measurements. (Accomplishing this level of performance is required in order for SIM to identify multi-planet solar systems out to 10 parsecs.)
  - Terrestrial Planet Finder (TPF): Provide studies and integrated models of mission architecture concepts.
  - Gamma-ray Large Area Space Telescope (GLAST): Conduct Large Area Telescope Preliminary Design Review (PDR).
  - Herschel Space Observatory: Complete the SPIRE qualification model detectors.
  - StarLight: Conduct Preliminary Design Review (PDR).
  - Outer Planets Program: Complete evaluation and restructuring of Outer Planets Program.
  - In-Space Propulsion: Compete and select Phase I award(s) for electric propulsion technology development.
  - Living With a Star: Announce instrument investigations for Solar Dynamics Observatory (SDO) mission.

Public Benefit: Careful stewardship of public money requires that challenging new technologies be evaluated via cost-effective demonstration and precursor missions so that NASA's most ambitious research facilities can be reliably developed using proven technologies.

APG 2S11: Earn external review rating of "green" on making progress in the following technology validation area:

- Formulate and implement cost-effective space demonstrations of selected technologies on suitable carriers.

  Indicator

  Meet no fewer than 66% of the performance objectives for flight validation.
  - Flight Validation/New Millennium Program: Conduct Space Technology 6 (ST-6) Confirmation Review.
  - Flight Validation/New Millennium Program: Conduct New Millennium Carrier-1 (NMC-1) Confirmation Review.
  - Flight Validation/New Millennium Program: Conduct Space Technology 5 (ST-5) Critical Design Review (CDR).

Strategic Plan Goal:

Education and Public Outreach: **Share the excitement and knowledge generated by scientific discovery and improve science education.**

Objectives: Share the excitement of space science discoveries with the public. Enhance the quality of science, mathematics, and technology education, particularly at the pre-college level. Help create our 21st Century scientific and technical workforce.

Public Benefit: Space Science Enterprise education and public outreach goals center on sharing the results of our missions and research programs with wide audiences and using space science discoveries as vehicles to improve teaching and learning at all levels. This is a deliberate expansion of the traditional role of the Enterprise in supporting graduate and postgraduate professional education, a central element of meeting our responsibility to help create the scientific workforce of the future. Our commitment to education includes a special emphasis on pre-college education and on increasing the general public's understanding and appreciation of science, mathematics, and technology.

APG 2S12: Earn external review rating of "green," on average, on making progress in the following focus areas:

- Incorporate a substantial, funded education and outreach program into every space science flight mission and research program.
- Increase the fraction of the space science community that contributes to a broad public understanding of science and is directly involved in education at the pre-college level.
- Establish strong and lasting partnerships between the space science and education communities.
- Develop a national network to identify high-leverage education and outreach opportunities and to support long-term partnerships.
- Provide ready access to the products of space science education and outreach programs.
- Promote the participation of underserved and underutilized groups in the space science program by providing new opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs.
- Develop tools for evaluating the quality and impact of space science education and outreach programs.

Indicator

Meet no fewer than six (75%) of the eight performance objectives for education and public outreach (E/PO).

- Ensure that every mission initiated in FY 2002 has a funded E/PO program, with a comprehensive E/PO plan prepared by its Critical Design Review (CDR).
- Establish a baseline for the number of space scientists who are participating in E/PO activities. This baseline will be used in the future to track success in increasing the fraction of the space science community that is directly involved in pre- college education and is contributing to a broad public understanding of science.
- Plan and/or implement Enterprise-funded E/PO activities taking place in at least forty states.
- Ensure that at least ten Enterprise-sponsored research, mission development or operations, or education projects are underway in Historically Black Colleges and Universities, Hispanic Serving Institutions, and Tribal Colleges, with at least three being underway in an institution of each type.
- Provide exhibits, materials, workshops, and personnel at a minimum of five national and three regional education and outreach conferences.
- Ensure that at least eight major Enterprise-sponsored exhibits or planetarium shows will be on display or on tour at major science museums or planetariums across the country.
- Prepare the second comprehensive Space Science Education/Outreach Report describing participants, audiences, and products for Enterprise E/PO programs.
- Initiate a major external review of the accomplishments of the Space Science E/PO efforts over the past five years, and complete a pilot study directed towards the eventual development of a comprehensive approach to assessing the

E/PO program's long-term effectiveness and educational impact. Use the preliminary results of both studies to guide adjustments in program direction and content.

VERIFICATION AND VALIDATION

Internal Assessment and Verification

The Space Science program consists of numerous diverse components, and each component's performance must be assessed in an appropriate way. For some program elements, such as mission and technology development, achievement of major milestones can be assessed through routine project management reviews. For missions in an operational phase, success can be gauged in terms of operating efficiency or major data sets returned. In each of these cases, performance assessment data is retrieved from normal project management reporting during the course of the fiscal year, and is verified and validated by the cognizant Program Executive or Program Scientist.

External Assessment and Verification

For the basic research programs, evaluation must consider important contextual factors such as: the relative value of the research objectives; progress toward those objectives; productivity by prevailing research community standards; and impact on related research funded or performed by other agencies. Measures such as number of grants or scientists supported, publication counts, or research citations are not able to capture these important aspects of the evaluation requirement. The best way to assess research programs has been demonstrated to be an external peer review approach. The Enterprise will employ this mechanism to qualitatively assess the progress of its programs in basic research and data analysis against Enterprise strategic plan science goals and objectives. The reviews will determine whether outcomes of these programs are fully effective, are not as strong as desired but have returned results of significant value, or are not scientifically or technologically competitive. The review process will also identify those programs that have produced important unexpected results or have contributed to an unanticipated degree to other research.

External Validation

At the conclusion of the assessment and verification process, the performance results will be reviewed and validated by the NASA Advisory Council.

MULTI-YEAR PERFORMANCE TREND

Space Science Enterprise (SSE)

Solve mysteries of the universe.

	FY 1999	**FY 2000**	**FY 2001**	**FY 2002**
Annual Performance Goal and APG #	9S1: Successfully launch seven spacecraft, within 10% of budget, on average.			
Assessment	Blue			
Annual Performance Goal and APG #	9S2: Measure the Hubble constant within an accuracy of about 10 percent, as compared to previous measurements that differ among themselves by a factor of two. (R&A)			
Assessment	Green			
Annual Performance Goal and APG #	9S3:Record 25 images and spectra at a resolution of better than an arcsecond, five to ten times sharper than images gathered earlier by the Einstein Observatory (CXO)	OS1: The Chandra X-ray Observatory (formerly AXAF) instrument will meet nominal performance expectations, and science data will be taken with 70% efficiency, with at least 90% of science data recovered on the ground.		
Assessment	Green	Green		

Solve mysteries of the universe.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9S4: Record data on approximately 12 compact stellar objects with a sensitivity 50 times greater than the Einstein Observatory.(CXO)			
Assessment	Green			
Annual Performance Goal and APG #	9S5: Observe physical phenomena 25,000 times closer to the event horizon of black holes than permitted with optical wavelength measurements. (RXTE)	OS2:The baseline RXTE mission ended in 1997; the target for FY00 is to operate at least three of the five instruments at an efficiency of 45%, with 95% data recovery; All Sky Monitor data will be posted on the web within 7 days, and Proportional Counter Array and High-Energy X-ray Timing Experiment data will be released within 60 days.		
Assessment	Green	Green		
Annual Performance Goal and APG #		OS3: Complete final integration and test of the Gravity Probe-B science payload with the spacecraft in August 2000.		
Assessment		Yellow		

Solve mysteries of the universe.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		OS4: Successfully install and activate three key Hubble upgrades during the third servicing mission: flight computer, advanced camera, and solar arrays. Maintain an average on-target pointing efficiency of 35% during FY00 operations before they are interrupted for the third servicing mission, presently scheduled for May 2000.		
Assessment		Yellow		
Annual Performance Goal and APG #		OS43: Complete the SOFIA 747 Section 46 mockup test activity during June 2000, with no functional test discrepancies that would invalidate CDR-level designs and cause significant design rework, with attendant cost and schedule impact.		
Assessment		Green		

Solve mysteries of the universe.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S5: Deliver the SIRTF Infrared Array Camera (IRAC), Multiband Imaging Photometer (MIPS), and Infrared Spectrograph (IRS) instruments during April 2000. The instruments shall perform at their specified levels at delivery.		
Assessment		Yellow		
Annual Performance Goal and APG #		0S6: Prepare the INTEGRAL Science Data Center (ISDC) for data archiving and prepare instrument analysis software for the spectrometer on INTEGRAL (SPI) instrument within 10% of estimated cost.		
Assessment		Green		
Annual Performance Goal and APG #		0S7:Assemble and successfully test the breadboard cooler for ESA's Planck mission in April 2000.		
Assessment		Yellow		

Solve mysteries of the universe.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S8: Deliver the GALEX science instrument from JPL to the Space Astrophysics Laboratory at Caltech during April 2000 for science calibration. The instrument will be fully integrated, functionally tested, and environmentally qualified at the time of the scheduled delivery.		
Assessment		Yellow		
Annual Performance Goal and APG #		0S9: Begin system-level environmental testing of the MAP spacecraft during July 2000.		
Assessment		Green		
Annual Performance Goal and APG #		0S11:The baseline mission of the CGRO ended in 1996; the target for FY00 is to continue to operate those instruments not dependent on expended consumables (Oriented Scintillation Spectrometer Experiment, OSSE; Burst and Transient Source Experiment, BATSE; and Imaging Compton Telescope, COMPTEL) at an average efficiency of at least 60%.		
Assessment		Green		

Solve mysteries of the universe.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S12: The 3-year FUSE mission will complete at least one-third of the observations needed for its minimum science program, with six of the eight instrument performance parameters being met.		
Assessment		Green		
Annual Performance Goal and APG #		0S15: The prime mission of SAMPEX ended in 1995; the FY00 target is to obtain at least 60% data coverage from at least three of SAMPEX's four instruments.		
Assessment		Green		
Annual Performance Goal and APG #		0S14: If launched, activate the XRS and XIS instruments on the Japanese Astro-E spacecraft after launch and collect at least 90% of the XRS and XIS data.		
Assessment		Red		

Solve mysteries of the universe.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S53: Complete the NGST Developmental Cryogenic Active Telescope Testbed (DCATT) phase 1, measure ambient operation with off-the-shelf components, and make final preparations for phase 2, the measurement of cold telescope operation with selected "flight-like" component upgrades.		
Assessment		Red		
Annual Performance Goal and APG #		0S62: Demonstrate performance of the Superconductor-Insulator-Superconductor (SIS) mixer to at least 8hv/k at 1,120 GHz and 10hv/k at 1,200 GHz. The U.S. contribution to the ESA FIRST is the heterodyne instrument, which contains the SIS receiver.		
Assessment		Yellow		
Annual Performance Goal and APG #		0S63: The prototype primary instrument for GLAST will demonstrate achievement of the established instrument performance level of angular resolution of 3.5 degrees across the entire 20-MeV to 100-GeV energy range.		
Assessment		Green		

Solve mysteries of the universe.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S65: Based on an overall goal of successfully launching 25 sounding rocket missions, at least 23 payloads shall successfully achieve their required altitude and orientation, and at least 21 investigators shall achieve their minimum mission success goals.		
Assessment		Red		
Annual Performance Goal and APG #		0S66: Based on an overall goal of conducting 26 worldwide science and technology demonstration balloon missions, at least 23 campaigns shall successfully achieve altitude and distance, and investigators' instrumentation shall function as planned for at least 19 missions.		
Assessment		Red		
Annual Performance Goal and APG #			1S1: Successfully develop and launch no fewer than three of four planned missions within 10% of budget and schedule. Missions are: GALEX, MAP, GP-B, and CATSAT. (Indicators have also been established for other missions in development.)	
Assessment			TBD	

Solve mysteries of the universe.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #			1S2: Obtain expected scientific data from at least 80% of operating missions. Missions are: HST, CXO, XTE, ACE, FUSE, SWAS, and, if successfully launched, GALEX, and GP-B.	
Assessment			TBD	
Annual Performance Goal and APG #			1S3: Perform innovative scientific research and technology development by meeting technology development objectives for major projects, by achieving mission success in astronomy rocket and balloon flights, and by making satisfactory research progress in related Research and Analysis (R&A) and Data Analysis (DA) programs. Meet no fewer than 66% of the performance objectives for the following technology and research programs NGST, Herschel (FIRST), GLAST, Sounding Rockets, Balloons, and R&A. Achieve a "fully effective" (green) overall science achievement rating from the Space Science external advisory committee. (#1S3)	
Assessment			TBD	

Understand the structure of the Universe, from its earliest beginnings to its ultimate fate.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				2S1: Earn external review rating of "green," on average, on making progress in the following research focus areas: • Identify dark matter and learn how it shapes galaxies and systems of galaxies. • Determine the size, shape, age, and energy content of the universe.
Assessment				TBD

Explore the ultimate limits of gravity and energy in the Universe.

Annual Performance Goal and APG #				2S2: Earn external review rating of "green," on average, on making progress in the following research focus areas: • Discover the sources of gamma ray bursts and high-energy cosmic rays. • Test the general theory of relativity near black holes and in the early universe, and search for new physical laws using the universe as a laboratory. • Reveal the nature of cosmic jets and relativistic flows.
Assessment				TBD

Learn how galaxies, stars, and planets form, interact, and evolve.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				2S3: Earn external review rating of "green," on average, on making progress in the following research focus areas: • Observe the formation of galaxies and determine the role of gravity in this process. • Establish how the evolution of a galaxy and the life cycle of stars influence the chemical composition of material available for making stars, planets, and living organisms. • Observe the formation of planetary systems and characterize their properties. • Use the exotic space environments within our Solar System as natural science laboratories and cross the outer boundary of the Solar System to explore the nearby environment of our galaxy.
Assessment				TBD

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9S6: Orbit Eros closer than 50 kilometers, 20-30 times closer than previous asteroid flybys. (NEAR)	0S16: NEAR will successfully orbit 433 Eros and meet primary scientific objectives while not exceeding projected mission cost by more than 10%.		
Assessment	Yellow	Green		
Annual Performance Goal and APG #	9S7: Measure the shape of Eros to an accuracy of 1 kilometer or better, about 10 times better than previous measurements, and measure the asteroid's mass to an accuracy of 20 percent. (NEAR)			
Assessment	Green			
Annual Performance Goal and APG #	9S8: Complete the first direct compositional measurements of an asteroid. (NEAR)			
Assessment	Yellow			
Annual Performance Goal and APG #	9S9: Map the 75 to 80 percent of the Moon's surface not accessible during the Apollo missions conducted from 1969 to 1972. (Lunar Prospector)			
Assessment	Green			

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9S10:Provide definitive measurements of the weak lunar magnetic field. (Lunar Prospector)			
Assessment	Green			
Annual Performance Goal and APG #	9S11: Provide these data with spatial resolution five times better than were collected from the Yohkoh Soft X-ray Telescope. (TRACE)	0S17: Collect pixel-limited images in all Transition Region and Coronal Explorer (TRACE) wavelength bands, operating 24-hour schedules for sustained periods over eight months.		
Assessment	Green	Green		
Annual Performance Goal and APG #		0S29: Deliver the Mars '01 Orbiter and Lander science instruments that meet capability requirements by June 1, 2000; prelaunch Gamma Ray Spectrometer (GRS) tests shall determine abundances in known calibration sources to 10% accuracy.		
Assessment		Yellow		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S30: Assuming the Mars Surveyor program architecture is confirmed, meet the milestones for the Mars 03 instrument selection and initiate implementation of the Lander mission. Deliver engineering models of the radio-frequency subsystem and antennae for the radar sounder instrument to ESA (if ESA approves the Mars Express mission), and select the contractors for the major system elements of the Mars Surveyor 05 mission.		
Assessment		Yellow		
Annual Performance Goal and APG #		0S20: The Rosetta project will deliver the electrical qualification models for the four U.S.-provided instruments to ESA in May 2000 for integration with the Rosetta Orbiter.		
Assessment		Green		
Annual Performance Goal and APG #		0S18: The TIMED mission will be delivered on time for a planned May 2000 launch, within 10% of the planned development budget.		
Assessment		Yellow		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S19:If successfully launched, the TIMED mission will acquire global data in the mesosphere and lower thermosphere/ionosphere region globally (all the latitudes) for at least 90 days at the required spatial resolution, coverage, and accuracy and for all local solar times.		
Assessment		Yellow		
Annual Performance Goal and APG #		0S21: Complete the development of the Cluster-II instrument analysis software for the one U.S. and five U.S.-partnered instruments before launch and, if launch occurs in FY00, activate and verify the wideband data and U.S. sub-components after launch.		
Assessment		Green		
Annual Performance Goal and APG #		0S22: HESSI will be delivered in time for a planned July 2000 launch, within 10% of the planned development budget.		
Assessment		Yellow		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S23:Assuming launch and normal checkout, HESSI operations will return data to achieve at least the primary science objectives, with at least 80% coverage of the time allowed by orbit.		
Assessment		Yellow		
Annual Performance Goal and APG #		0S25: Deliver to the Los Alamos National Laboratory in March 2000 all components for system integration and testing of the first flight system for the TWINS mission.		
Assessment		Green		
Annual Performance Goal and APG #		0S26: IMAGE will be delivered on time for a planned February 2000 launch and within 10% of the planned development budget.		
Assessment		Green		
Annual Performance Goal and APG #		0S27: If launched, IMAGE will acquire critical measurements at minute time scales, returning 85% real-time coverage of Earth's magnetospheric changes.		
Assessment		Green		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S28: Select two Small Explorer (SMEX) missions and release a University Explorer (UNEX) Announcement of Opportunity (AO).		
Assessment		Red		
Annual Performance Goal and APG #		0S24: Acquire calibrated observational data from the Japanese Yohkoh high-energy solar physics mission (including the U.S.-provided SXT) for at least 75% of the time permitted by tracking coverage.		
Assessment		Green		
Annual Performance Goal and APG #		0S31: Complete Genesis spacecraft assembly and start functional testing in November 1999.		
Assessment		Green		
Annual Performance Goal and APG #		0S32: Release an AO for the next Discovery mission.		
Assessment		Green		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S42: Successfully complete the breadboard of the imager instrument for CONTOUR and award the contract for the propulsion system after a PDR that confirms the design and maintains 15% margins for mass and power.		
Assessment		Green		
Annual Performance Goal and APG #		0S45: The baseline Galileo mission ended in 1997; the target for FY00 is to recover at least 90% of playback data from at least one Galileo flyby of Io. *(also shown below, under "Search for Life Beyond Earth")*		
Assessment		Blue		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S40: The Mars Climate Orbiter (MCO) will aerobrake from its initial insertion orbit into a near-polar, Sun-synchronous, approximately 400-km circular orbit and will initiate mapping operations no later than May 2000, acquiring 70% of the available science data and relaying to Earth 70% of the data transmitted at adequate signal levels by the Mars Polar Lander (MPL).		
Assessment		Red		
Annual Performance Goal and APG #		0S41: MPL will successfully land on Mars in December 1999 and operate its science instruments for the 80-day prime mission with at least 75% of planned science data returned.		
Assessment		Red		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S46: The Mars Global Surveyor (MGS) will acquire 70% of science data available, conduct at least two five-day atmospheric mapping campaigns, and relay to Earth at least 70% of data transmitted at adequate signal levels by the Deep Space-2 Mars microprobes. *(also shown below, under "Mars, the Moon, and small bodies")*		
Assessment		Green		
Annual Performance Goal and APG #		0S33: Collect 85% of data acquired from the International Solar-Terrestrial Physics Program (ISTP) spacecraft and successfully execute the WIND trajectory plan.		
Assessment		Green		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		Cassini: Continue operations during the quiescent cruise phase without major anomalies, conduct planning for the Jupiter gravity-assist flyby, and explore early science data collection opportunities. The following in-flight activities will be completed: Instrument Checkout #2; uplink Articulation and Attitude Control Subsystem (AACS) software update with Reaction Wheel Authority capability; Command and Data Subsystem Version 8; and Saturn tour designs for selection by the Program Science Group. #OS34		
Assessment		Green		
Annual Performance Goal and APG #		0S35: Capture at least 90% of available Ulysses science data. These will be the only data observed from outside-of-the-ecliptic plane.		
Assessment		Green		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		Average 12 hours of Voyager Interstellar Mission data capture per day per spacecraft to characterize the heliosphere and the heliospheric processes at work in the outer solar system as well as the transition from the solar system to interstellar space. #OS36		
Assessment		Yellow		
Annual Performance Goal and APG #		0S37: Stardust: Continue spacecraft cruise operations without major anomalies and perform interstellar dust collection for at least 36 days.		
Assessment		Green		
Annual Performance Goal and APG #		0S38: FAST will return simultaneous data from high-latitude, low-altitude magnetosphere locations in the Sun-Earth connected system through solar maximum at the required resolution and accuracy with at least 85% efficiency.		
Assessment		Green		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S39: Collect and process data from the Interplanetary Monitoring Platform (IMP-8, launched in 1973), making data from at least six instruments available within 15 months and the magnetic field and plasma data available within 2 months.		
Assessment		Green		
Annual Performance Goal and APG #		0S48: ACE will measure the composition and energy spectra of heavy nuclei in at least eight solar energetic particle events; maintain real-time solar wind data transmissions at least 90% of the time; measure the isotopic composition of a majority of the "primary" galactic cosmic ray elements from carbon to zinc; and provide browse parameters within three days for 90% of the year.		
Assessment		Green		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S47: Complete the system CDR for the New Millennium Deep Space-4 (Champollion) project before the end of FY00, including successful completion of the avionics subsystem CDR and the mechanical subsystem CDR.		
Assessment		Red		
Annual Performance Goal and APG #		0S58: The Advanced Radioactive Power Source (ARPS), which is a partnership with the Department of Energy to develop small, robust, highly efficient radioisotope power sources, will accomplish the following five objectives on time and within budget in 2000: fabricate and test 15 prototype AMTEC cells by January; complete the final design of the AMTEC cells by March; complete the final design for a 75-watt ARPS by April; begin the prototype AMTEC four-cell lifetime test by April; and begin qualification unit fabrication by September.		
Assessment		Red		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S60: Complete and deliver for testing Solar-B's four Electrical Engineering Models in September 2000.		
Assessment		Yellow		
Annual Performance Goal and APG #		0S61: Complete STEREO Phase A studies by June 2000, including the release of an AO for investigations with specific instruments and selection of the formulation phase payload.		
Assessment		Yellow		
Annual Performance Goal and APG #		0S64: Successfully complete a preliminary design for either the Europa Orbiter or Pluto-Kuiper Express mission (whichever is planned for earlier launch) that is shown to be capable of achieving the Category 1A science objectives with adequate cost, mass, power, and other engineering margins.		
Assessment		Red		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S70: The first engineering model (EM-1) of the X2000 First Delivery will be delivered in September 2000. Successful development includes the integration of all EM-1 hardware, the functional verification of delivered hardware and software, and the ability to support ongoing testing, hardware integration, and software verification for delivered software.		
Assessment		Red		
Annual Performance Goal and APG #			1S4: Successfully develop and launch no fewer than one of two missions within 10% of budget and schedule. Missions are: Mars Odyssey ('01 Orbiter) and Genesis. (Indicators have also been established for other projects in development.)	
Assessment			TBD	

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #			1S5: Obtain expected scientific data from at least 80% of operating missions. Missions are: Cassini, Voyager, Ulysses, SAMPEX, FAST, TRACE, Stardust, Mars Global Surveyor, and ISTP spacecraft; also, if successfully launched, TIMED, HESSI, IMAGE, Genesis, and Mars Odyssey ('01 Orbiter).	
Assessment			TBD	

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #			1S6: Perform innovative scientific research and technology development by meeting technology development objectives for major projects, by achieving mission success in space physics rocket and balloon flights, and by making satisfactory research progress in related R&A and DA programs. Meet no fewer than 66% of the performance objectives for the following technology and research programs Solar-B, STEREO, Solar Probe, Future Solar Terrestrial Probes, Future Deep Space Technology, CISM, X2000, Sounding Rockets, and Balloons. Achieve a "fully effective" (green) overall science achievement rating from the Space Science external advisory committee.	
APG Assessment				

Understand the formation and evolution of the Solar System and the Earth within it.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				2S5: Earn external review rating of "green," on average, on making progress in the following research focus areas: • Inventory and characterize the remnants of the original material from which the Solar System formed. • Learn why the planets in our Solar System are so different from each other. • Learn how the Solar System evolves.
Assessment				TBD

Probe the evolution of life on Earth, and determine if life exists elsewhere in our Solar System.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				2S6: Earn external review rating of "green," on average, on making progress in the following research focus areas: • Investigate the origin and early evolution of life on Earth, and explore the limits of life in terrestrial environments that might provide analogues for conditions on other worlds. • Determine the general principles governing the organization of matter into living systems and the conditions required for the emergence and maintenance of life • Chart the distribution of life-sustaining environments within our Solar System, and search for evidence of past and present life. • Identify plausible signatures of life on other worlds.
Assessment				TBD

Understand our changing Sun and its effects throughout the Solar System.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				2S7: Earn external review rating of "green," on average, on making progress in the following research focus areas: • Understand the origins of long- and short-term solar variability. • Understand the effects of solar variability on the solar atmosphere and heliosphere. • Understand the space environment of Earth and other planets.
Assessment				TBD

Chart our destiny in the Solar System.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				2S8: Earn external review rating of "green," on average, on making progress in the following research focus areas: • Understand forces and processes, such as impacts, that affect habitability of Earth. • Develop the capability to predict space weather. • Find extraterrestrial resources and assess the suitability of Solar System locales for future human exploration.
Assessment				

Discover planets around other stars.

Annual Performance Goal and APG #	9S12:Assemble and lab-test the interferometer beam combiner. This state-of-the-art system will approximately double observational efficiency by using a new approach to fringe detection. (Keck)	0S55: Development of the interferometer program for connecting the twin Keck 10-meter telescopes with an array of four two-meter class outrigger telescopes will be tested by detecting and tracking fringes with two test siderostats at two- and ten-micron wave		
Assessment	Green	Yellow		

Discover planets around other stars.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S52: The Space Interferometry Mission (SIM) System Testbed (STB) will demonstrate, in May 2000, that an rms optical path difference can be controlled at 1.5 nanometers, operating in an emulated on-orbit mode.		
Assessment		Green		
Annual Performance Goal and APG #		0S54: Complete and deliver a technology development plan for the Terrestrial Planet Finder (TPF) mission by June 2000. This infrared interferometer mission is projected for a 2010 launch and requires the definition of technologies that will not be developed or demonstrated by precursor missions.		
Assessment		Red		

Discover planets around other stars.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #			1S7: Perform innovative scientific research and technology development by meeting interferometry technology development objectives and by making satisfactory research progress in related R&A programs. Meet no fewer than 66% of the performance objectives for SIM, TPF, ST-3, Keck, and R&A. Achieve a "fully effective" (green) overall science achievement rating from the Space Science external advisory committee.	
Assessment			TBD	

Look for signs of life in other planetary systems.

Annual Performance Goal and APG #				2S4: Earn external review rating of "green," on average, on making progress in the following research focus areas: • Discover planetary systems of other stars and their physical characteristics. • Search for worlds that could or do harbor life.
Assessment				

Search for life beyond Earth.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9S13: Successfully complete and receive scientific data from at least 8 of 10 planned data-taking encounters with Europa. (Galileo)			
Assessment	Green			
Annual Performance Goal and APG #	9S14: Bring the total mapping coverage to about 1 percent of the surface at about 30-meter resolution, and multispectral coverage distributed over 50 percent of the surface at lower resolution. (Galileo)			
Assessment	Green			
Annual Performance Goal and APG #	9S17: Initiate Institute operations by linking up to 8 institutions and engaging approximately 50 investigators. (Astrobiology Institute)			
Assessment	Green			
Annual Performance Goal and APG #		0S56:The Europa Orbiter project will successfully complete a PDR in March 2000 and will begin the integration and test of the Avionics Engineering Model in July 2000.		
Assessment		Red		

Search for life beyond Earth.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #			1S8:Perform innovative scientific research and technology development by meeting technology development objectives and by making satisfactory research progress in the related R&A program, including the Astrobiology program. Meet no fewer than two of the three performance objectives for Europa Orbiter, Astrobiology, and R&A. Achieve a "fully effective" (green) overall science achievement rating from the Space Science external advisory committee.	
Assessment			TBD	
Annual Performance Goal and APG #			1S14: Advance the search for life beyond Earth by successfully launching a Mars mission, by obtaining data from operational spacecraft, and by performing innovative technology development. Meet no fewer than two of the three performance objectives for Mars Odyssey ('01 Orbiter), Mars Global Surveyor, and Terrestrial Planet Finder.	
Assessment			TBD	

Investigate the composition, evolution, and resources on Mars, the Moon, and small bodies.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9S15: Achieve the final science orbit. (MGS)			
Assessment	Green			
Annual Performance Goal and APG #	9S19: Measure the topography with 10-meter precision, about 100 times more accurate than previous measurements. (MGS)			
Assessment	Blue			
Annual Performance Goal and APG #	9S20: Provide high-resolution 1.5-meter imaging data, 10 times more detailed than the best imaging from the 1976 Viking mission. (MGS)			
Assessment	Green			
Annual Performance Goal and APG #	9S21: Provide the first thermal infrared spectrometry of the planet. (MGS)			
Assessment	Green			

Investigate the composition, evolution, and resources on Mars, the Moon, and small bodies.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #			1S10: Investigate the composition, evolution, and resources of Mars, the Moon, and small bodies by successfully launching a Mars mission, by obtaining data from operational spacecraft, and by making satisfactory progress in related R&A and DA programs. Meet no fewer than 75% of the performance objectives for Mars Odyssey ('01 Orbiter), CONTOUR, Mars Global Surveyor, and R&A. Achieve a "fully effective" (green) overall science achievement rating from the Space Science external advisory committee.	
Assessment			TBD	

Improve the reliability of space weather forecasting.

Annual Performance Goal and APG #	9S22: Achieve complete coverage (maximum and minimum) of the solar cycle, an increase from 35 percent. (Space Physics fleet of spacecraft)	*(Refer to Space Physics spacecraft targets under "Explore the Solar System.")*		
Assessment	Green			

Improve the reliability of space weather forecasting.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #			1S11: Develop the knowledge to improve the reliability of space weather forecasting by obtaining scientific data from three of five missions and by making satisfactory progress in related areas in R&A and DA programs. Meet no fewer than 75% of the performance objectives for R&A, ACE, SAMPEX, TRACE, ISTP, and, if successfully launched, HESSI. Achieve a "fully effective" (green) overall science achievement rating from the Space Science external advisory committee.	
Assessment			TBD	

Improve the reliability of space weather forecasting.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #			1S13: Further understanding of basic natural processes and the effects of solar variability on humans and technology. Meet no fewer than two of the three performance objectives for: Strategic Plan Development, Solar Dynamics Observatory, and Research and Data Analysis. Achieve a "fully effective' (green) overall science achievement rating from the Space Science external advisory committee.	
Assessment			TBD	
Annual Performance Goal and APG #	9S24: Demonstrate an improvement in measurement precision for optical path lengths in laser light to the 100-picometer (million-millionths of a meter) range. (Micro-Arcsecond Metrology Testbed)			
Assessment	Yellow			

Improve the reliability of space weather forecasting.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9S25: Demonstrate an advanced robotic manipulator with an order of magnitude performance improvement compared to the manipulator used on Viking in 1976. (Robotic Manipulator, Mars Polar Lander)			
Assessment	Green			
Annual Performance Goal and APG #		OS49: Information Systems R&T will demonstrate the search, discovery, and fusion of multiple data products at a major science meeting. Accomplish and document the infusion of five information systems R&T efforts into flight projects or the broad research community. Space science data services shall be acknowledged as enabling for two interdisciplinary collaborations.		
Assessment		Green		

Improve the reliability of space weather forecasting.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S50: The Remote Exploration and Experimentation element of the HPCC program will demonstrate software-implemented fault tolerance for science teams' applications on a first-generation embedded computing testbed, with the applications' sustained performance degraded by no more than 25% at fault rates characteristic of deep space and low-Earth orbit.		
Assessment		Yellow		
Annual Performance Goal and APG #		In April 2000, the Center for Integrated Space Microelectronics will deliver to the X2000 First Delivery project the first engineering model of an integrated avionics system that includes the functionality of command and data handling, attitude control, power management and distribution, and science payload interface. The system will be used on the Europa Orbiter and other missions. #OS57		
Assessment		Red		

Develop new technologies needed to carry out innovative and less costly mission and research concepts.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #			1S12: Plan, develop, and validate new technologies needed to enable future research and flight missions by achieving performance objectives in the space science core technology programs and by making progress as planned in the Flight Validation program. Meet no fewer than 66% of the performance objectives for Information Systems, High Performance Computing, Explorer Program Technology, and Flight Validation.	
Assessment			TBD	

Acquire new technical approaches and capabilities. Validate new spacecraft capabilities in space. Apply and transfer technology.

Annual Performance Goal and APG #				2S10: Earn external review rating of "green" on making progress in the following technology development area: • Focus technology development on a well-defined set of performance requirements covering the needs of near-term to mid-term strategic plan missions.
Assessment				TBD

Acquire new technical approaches and capabilities. Validate new spacecraft capabilities in space. Apply and transfer technology.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				2S11: Earn external review rating of "green" on making progress in the following technology validation area: • Formulate and implement cost-effective space demonstrations of selected technologies on suitable carriers.
Assessment				TBD

Incorporate education and enhanced public understanding of science as integral components of space science missions and research.

Annual Performance Goal and APG #	9S26: Account for 4 percent of the 150 "most important science stories" in the annual review by *Science News*.			
Assessment	Green			
Annual Performance Goal and APG #	9S27: Account for no less than 25 percent of total contributions to the college textbook *Astronomy: From the Earth to the Universe*.			
Assessment	Green			
Annual Performance Goal and APG #	9S28: Each new Space Science Enterprise mission initiated in FY 1999 will have a funded education and outreach program.			
Assessment	Green			

Incorporate education and enhanced public understanding of science as integral components of space science missions and research.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9S29: The Space Science Enterprise will complete an organized network of contacts by the end of FY 1999 to work with educators and space scientists to formulate and implement space science education and outreach programs. This network will be available to every state in the United States.	0S67: Successful achievement of at least seven of the following eight objectives will be made. (1) Each new Space Science mission will have a funded education and outreach program. (2) By the end of FY00, 10% of all Space Science research grants will have an associated education and outreach program under way. (3) Twenty-six states will have Enterprise-funded education or outreach programs planned or underway. (4) At least five research, mission development/ operations, or education programs will have been planned/undertaken in Historically Black Colleges and Universities, Hispanic Serving Institutions, or Tribal Colleges, with at least one project underway in each group. (5) At least three national and two regional educational or outreach conferences will be supported with a significant Space Science presence. (6) At least three exhibits or		

		planetarium shows will be on display. (7) An online directory providing enhanced access to major Space Science-related products and programs will be operational by end of the fiscal year. (8) A comprehensive approach to assessing the effectiveness and impact of the Space Science education and outreach efforts will be under development, with a pilot test of the evaluation initiated.		
Assessment	Green	Green		

Make education and enhanced public understanding of science an integral part of our missions and research.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #			1S9: Continue and expand the integration of education and enhanced public understanding of science with Enterprise research and flight mission programs. Meet no fewer than 75% of the eight performance objectives for education and public outreach.	
Assessment			TBD	

Share the excitement of space science discoveries with the public. Enhance the quality of science, mathematics, and technology education, particularly at the pre-college level. Help create our 21st Century scientific and technical workforce.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				2S12: Earn external review rating of "green," on average, on making progress in the following focus areas: • Incorporate a substantial, funded education and outreach program into every space science flight mission and research program. • Increase the fraction of the space science community that contributes to a broad public understanding of science and is directly involved in education at the pre-college level. • Establish strong and lasting partnerships between the space science and education communities. • Develop a national network to identify high-leverage education and outreach opportunities and to support long-term partnerships. • Provide ready access to the products of space science education and outreach programs. • Promote the participation of underserved and

				underutilized groups in the space science program by providing new opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs. • Develop tools for evaluating the quality and impact of space science education and outreach programs.
Assessment				TBD

Multi-theme / support all objectives.

	FY 1999	**FY 2000**	**FY 2001**	**FY 2002**
Annual Performance Goal and APG #		0S68: Conduct research and analysis.		
Assessment		Green		
Annual Performance Goal and APG #		0S69: Conduct data analysis.		
Assessment		Green		

Support of Strategic Plan Science Objectives; Development/ Near-Term Future Investments (supports all objectives under the Science goal)

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				2S9: Earn external review rating of "green" on making progress in the following area: • Design, develop, and launch projects to support future research in pursuit of Strategic Plan science objectives.
Assessment				TBD

Space Science Enterprise FY 2002	Budget Category	SIRTF	HST Development	GP-B	SOFIA	STEREO	Payloads	Explorers	Discovery	Mars Surveyor	Operating Missions	SR&T
Annual Performance Goal & APG #												
2S1: Earn external review rating of "green," on average, on making progress in the following research focus areas: (1) Identify dark matter and learn how it shapes galaxies and systems of galaxies. (2) Determine the size, shape, age, and energy content of the universe.											X	X
2S2: Earn external review rating of "green," on average, on making progress in the following research focus areas: (1) Discover the sources of gamma ray bursts and high energy cosmic rays. (2) Test the general theory of relativity near black holes and in the early universe, and search for new physical laws using the universe as a laboratory. (3) Reveal the nature of cosmic jets and relativistic flows.											X	X
2S3: Earn external review rating of "green," on average, on making progress in the following research focus areas: (1) Observe the formation of galaxies and determine the role of gravity in this process. (2) Establish how the evolution of a galaxy and the life cycle of stars influence the chemical composition of material available for making stars, planets, and living organisms. (3) Observe the formation of planetary systems and characterize their properties. (4) Use the exotic space environments within our Solar System as natural science laboratories and cross the outer boundary of the Solar System to explore the nearby environment of our galaxy.											X	X

Space Science Enterprise FY 2002	Budget Category	SIRTF	HST Development	GP-B	SOFIA	STEREO	Payloads	Explorers	Discovery	Mars Surveyor	Operating Missions	SR&T
2S4: Earn external review rating of "green," on average, on making progress in the following research focus areas: (1) Discover planetary systems of other stars and their physical characteristics. (2) Search for worlds that could or do harbor life.											X	X
2S5: Earn external review rating of "green," on average, on making progress in the following research focus areas: (1) Inventory and characterize the remnants of the original material from which the Solar System formed. (2) Learn why the planets in our Solar System are so different from each other. (3) Learn how the Solar System evolves.											X	X
2S6: Earn external review rating of "green," on average, on making progress in the following research focus areas: (1) Investigate the origin and early evolution of life on Earth, and explore the limits of life in terrestrial environments that might provide analogues for conditions on other worlds. (2) Determine the general principles governing the organization of matter into living systems and the conditions required for the emergence and maintenance of life. (3) Chart the distribution of life-sustaining environments within our Solar System, and search for evidence of past and present life. (4) Identify plausible signatures of life on other worlds.											X	X

Space Science Enterprise FY 2002	Budget Category	SIRTF	HST Development	GP-B	SOFIA	STEREO	Payloads	Explorers	Discovery	Mars Surveyor	Operating Missions	SR&T
2S7: Earn external review rating of "green," on average, on making progress in the following research focus areas: (1) Understand the origins of long- and short-term solar variability. (2) Understand the effects of solar variability on the solar atmosphere and heliosphere. (3) Understand the space environment of Earth and other planets.											X	X
2S8: Earn external review rating of "green," on average, on making progress in the following research focus areas: (1) Understand forces and processes, such as impacts, that affect habitability of Earth. (2) Develop the capability to predict space weather. (3) Find extraterrestrial resources and assess the suitability of Solar System locales for future human exploration.											X	X
2S9: Earn external review rating of "green" on making progress in the following area: Design, develop, and launch projects to support future research in pursuit of Strategic Plan science objectives.		X	X	X	X	X	X	X	X	X		
2S10: Earn external review rating of "green" on making progress in the following technology development area: Focus technology development on a well-defined set of performance requirements covering the needs of near-term to mid-term strategic plan missions.												X

Space Science Enterprise FY 2002	Budget Category	SIRTF	HST Development	GP-B	SOFIA	STEREO	Payloads	Explorers	Discovery	Mars Surveyor	Operating Missions	SR&T
2S11: Earn external review rating of “green” on making progress in the following technology validation area: Formulate and implement cost-effective space demonstrations of selected technologies on suitable carriers.												X
2S12: 'Earn external review rating of “green,” on average, on making progress in the following focus areas: (1) Incorporate a substantial, funded education and outreach program into every space science flight mission and research program. (2) Increase the fraction of the space science community that contributes to a broad public understanding of science and is directly involved in education at the pre-college level. (3) Establish strong and lasting partnerships between the space science and education communities. (4) Develop a national network to identify high-leverage education and outreach opportunities and to support long-term partnerships. (5) Provide ready access to the products of space science education and outreach programs. (6) Promote the participation of underserved and underutilized groups in the space science program by providing new opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs. (7) Develop tools for evaluating the quality and impact of space science education and outreach programs.		X	X	X	X	X	X	X	X	X	X	X

Space Science Enterprise (SSE)

Mission

The primary goal of the Space Science Enterprise is to chart the evolution of the universe from origins to destiny, and improve understanding of galaxies, stars, planets, and life (Figure 2). Within this goal, Enterprise objectives are to: understand the structure of the universe, from its earliest beginnings to its ultimate fate; explore the ultimate limits of gravity and energy in the universe; learn how galaxies, stars and planets form, interact, and evolve; look for signs of life in other planetary systems; understand the formation and evolution of the Solar System and Earth within it; probe the origin and evolution of life on Earth and determine if life exists elsewhere in our Solar System; understand our changing Sun and its effects throughout the Solar System; and chart our destiny in the Solar System. Other Enterprise goals include developing innovative technologies to support Space Science programs and making them available for other applications that benefit the Nation. Enterprise missions and research also yield scientific information of value for future exploration programs. Knowledge and discoveries will be shared with the public to enhance science, mathematics, and technology education and increase the scientific and technological literacy of all Americans.

Implementation Strategy

The Space Science Enterprise Performance Plan is tied directly to the Enterprise Strategic Plan. The Strategic Plan is based on science goals and objectives, with research and flight programs structured to implement these goals. The Enterprise continues to use scientific merit as the primary criterion for program planning and resource commitment. In implementing this program, the Enterprise will preserve safety as NASA's number one priority, with balanced risks between missions to ensure overall achievement of program goals.* Properly implemented, the "faster, better, cheaper" approach does not jeopardize this priority. Projects will not be approved for implementation until a clear technology path to successful implementation is demonstrated. These new technologies will be applied aggressively, within the constraints of prudent stewardship of public investment.

The Enterprise will continue to ensure the active participation of the research community outside NASA in planning, flight programs, research investigations, and peer review; this participation is viewed as being critical to the program's success. Collaborative efforts with other Federal agencies, such as the National Science Foundation, Department of Defense and Department of Energy, as well as with international partners, play a key role in the implementation strategy of the Enterprise. Finally, a fundamental consideration in planning and conducting all of our programs is the recognition that the national investment in space science is a public trust. The Enterprise places a very high priority on sharing the results and excitement of our programs through the formal education system and public engagement.

[*Note: Safety as it applies to human space flight does not apply to Space Science missions and would be prohibitively expensive if it did. Moreover, Space Science missions should not all have the same risk profile. For example, a balance of lower-risk (e.g., Chandra) and higher-risk (e.g., Explorer) missions should be used to maximize science return per dollar.]

Enterprise Resource Requirements

The President has requested the following budget for FY99 to FY02 to support the accomplishment of Space Science goals:

	FY 1999	FY 2000	FY 2001	FY 2002
NOA $M	2119	2,194	2,321	2,867
CS FTEs	1,846	2,362	2,064	2,481

FY 2002 Performance Metrics

Strategic Plan Goal:
Science: **Chart the evolution of the Universe, from origins to destiny, and understand its galaxies, stars, planets, and life.**

Objective: Understand the structure of the Universe, from its earliest beginnings to its ultimate fate.

Public Benefit: One of the great quests of the last half-millennium since the time of Copernicus has been to understand where humanity fits within the Cosmos: What is the age of the Universe? How did it begin and how will it end? What are its primary constituents and how do they interact? NASA's pursuits in the research focus areas are intended to answer these questions.

APG 2S1: Earn external review rating of "green," on average, on making progress in the following research focus areas:

- Identify dark matter and learn how it shapes galaxies and systems of galaxies.
- Determine the size, shape, age, and energy content of the universe.

  Indicators
  - Demonstrate significant progress toward the goal, as determined by external expert review.
  - Obtain expected scientific data from 80% of operating missions supporting this goal (as identified and documented by Associate Administrator at beginning of fiscal year).

Objective: Explore the ultimate limits of gravity and energy in the Universe.

Public Benefit: The basic constituents of Nature interact via fundamental forces that are likely to be studied best by using the Universe as a giant laboratory of extreme environments. Understanding these forces will give us insight into the most important processes in Nature and may reveal "new physics" and new phenomena that cannot be created in any Earthbound laboratory.

APG 2S2: Earn external review rating of "green," on average, on making progress in the following research focus areas:

- Discover the sources of gamma ray bursts and high-energy cosmic rays.
- Test the general theory of relativity near black holes and in the early universe, and search for new physical laws, using the universe as a laboratory.
- Reveal the nature of cosmic jets and relativistic flows.

Indicators

- Demonstrate significant progress toward the goal, as determined by external expert review.
- Obtain expected scientific data from 80% of operating missions supporting this goal (as identified and documented by Associate Administrator at beginning of fiscal year).

Objective: Learn how galaxies, stars, and planets form, interact, and evolve.

Public Benefit: Life on Earth is the product of a complex sequence of events, which are at present only approximately understood. This sequence begins with the birth of the galaxies and continues through the creation of heavy elements inside stars and the birth of stars and other planetary systems. To understand how life arose on Earth, and perhaps elsewhere, a complete understanding of the entire "thread of life" in the Cosmos is necessary.

APG 2S3: Earn external review rating of "green" on average, on making progress in the following research focus areas:

- Observe the formation of galaxies and determine the role of gravity in this process.
- Establish how the evolution of a galaxy and the life cycle of stars influence the chemical composition of material available for making stars, planets, and living organisms.
- Observe the formation of planetary systems and characterize their properties.
- Use the exotic space environments within our Solar System as natural science laboratories and cross the outer boundary of the Solar System to explore the nearby environment of our galaxy.

Indicators

- Demonstrate significant progress toward the goal, as determined by external expert review.
- Obtain expected scientific data from 80% of operating missions supporting this goal (as identified and documented by Associate Administrator at beginning of fiscal year).

Objective: Look for signs of life in other planetary systems.

Public Benefit: "Are we alone?" is one of the most profound questions that humanity can ask, and its answer will affect almost every aspect of how humans view themselves and their place in the Universe.

APG 2S4: Earn external review rating of "green" on average, on making progress in the following research focus areas:

- Discover planetary systems of other stars and their physical characteristics.
- Search for worlds that could or do harbor life.

Indicators

- Demonstrate significant progress toward the goal, as determined by external expert review.
- Obtain expected scientific data from 80% of operating missions supporting this goal (as identified and documented by Associate Administrator at beginning of fiscal year).

Objective: Understand the formation and evolution of the Solar System and the Earth within it.

Public Benefit: Earth and all of the other bodies in the Solar System formed at about the same time from a disk of gas and dust that surrounded the Sun. While these bodies share some similarities, there are striking differences among them. A fundamental goal of the NASA Space Science Enterprise is to understand the physical conditions and processes that led to those

differences. What do these differences imply about the response of Earth's environment to natural and manmade influences? What do they imply about the likelihood of Earth-like planets, potential habitats for life, circling other stars?

APG 2S5: Earn external review rating of "green," on average, on making progress in the following research focus areas:

- Inventory and characterize the remnants of the original material from which the Solar System formed.
- Learn why the planets in our Solar System are so different from each other.
- Learn how the Solar System evolves.

  Indicators
  - Demonstrate significant progress toward the goal, as determined by external expert review.
  - Obtain expected scientific data from 80% of operating missions supporting this goal (as identified and documented by Associate Administrator at beginning of fiscal year).

Objective: Probe the evolution of life on Earth, and determine if life exists elsewhere in our Solar System.

Public Benefit: The organizing principles of life and its origin(s) are very poorly known, but at the same time are essential to understanding the biosphere, the Earth's layer of life. Understanding the origin and early evolution of life on Earth will permit a deeper understanding of the robustness (or fragility) of terrestrial life, life's interactions with the non-living world, and the dangers that life faces in an occasionally hostile environment.

APG 2S6: Earn external review rating of "green," on average, on making progress in the following research focus areas:

- Investigate the origin and early evolution of life on Earth, and explore the limits of life in terrestrial environments that might provide analogues for conditions on other worlds.
- Determine the general principles governing the organization of matter into living systems and the conditions required for the emergence and maintenance of life
- Chart the distribution of life-sustaining environments within our Solar System, and search for evidence of past and present life.
- Identify plausible signatures of life on other worlds.

  Indicators
  - Demonstrate significant progress toward the goal, as determined by external expert review.
  - Obtain expected scientific data from 80% of operating missions supporting this goal (as identified and documented by Associate Administrator at beginning of fiscal year).

Objective: Understand our changing Sun and its effects throughout the Solar System.

Public Benefit: Solar variability affects life and society by causing "space weather," which can affect space assets vital to the national economy (communications, weather, and military satellites), short wave radio communications, the electric power grid, and astronauts. Solar variability also is a natural driver of global climate change, which appears to have affected Earth's climate in the past.

APG 2S7: Earn external review rating of "green," on average, on making progress in the following research focus areas:

- Understand the origins of long- and short-term solar variability.

- Understand the effects of solar variability on the solar atmosphere and heliosphere.
- Understand the space environment of Earth and other planets.

  Indicators
  - Demonstrate significant progress toward the goal, as determined by external expert review.
  - Obtain expected scientific data from 80% of operating missions supporting this goal (as identified and documented by Associate Administrator at beginning of fiscal year).

Objective: Chart our destiny in the Solar System.

Public Benefit: The course of life on Earth has been profoundly altered by impacts of asteroids and/or comets. It is widely accepted that a major impact 65 million years ago led to the extinction of dinosaurs and cleared the way for the rise of mammals. An even greater impact more than 200 million years ago led to the extinction of about 90 percent of the species alive at the time.

Impacts did not end in prehistoric times. In 1908, a fragment of a comet or asteroid leveled hundreds of square miles of forest in the remote Siberian region of Tunguska; had the object fallen about four hours later, it would have annihilated the city of St. Petersburg. It is estimated that there are between 700 and 1000 objects whose orbits cross Earth's (these are known as Near Earth Objects, or NEOs), that are large enough to cause global catastrophe if they were to strike Earth. NASA Space Science supports the search for such NEOs, with a goal of identifying at least 90 percent of them by the year 2008 (nearly 500 have been discovered to date). By identifying those objects that actually have a potential to collide with Earth, we expect to have decades of advance warning in which to take countermeasures, if necessary.

APG 2S8: Earn external review rating of "green," on average, on making progress in the following research focus areas:

- Understand forces and processes, such as impacts, that affect habitability of Earth.
- Develop the capability to predict space weather.
- Find extraterrestrial resources and assess the suitability of Solar System locales for future human exploration.

  Indicators
  - Demonstrate significant progress toward the goal, as determined by external expert review.
  - Obtain expected scientific data from 80% of operating missions supporting this goal (as identified and documented by Associate Administrator at beginning of fiscal year).

Objective: Support of Strategic Plan Science Objectives; Development/ Near-Term Future Investments (Supports all objectives under the Science Goal)

Public Benefit: NASA has been chartered by the American people to undertake challenging scientific explorations of our Solar System and the Universe beyond by building and launching missions that will achieve ambitious scientific goals. Missions in development have moved beyond study and preliminary design, and into detailed design and fabrication. Once launched and operational, the images and data they provide will advance our understanding of our Solar System and the Universe in which we live.

APG 2S9: Earn external review rating of "green" on making progress in the following area:

- Design, develop, and launch projects to support future research in pursuit of Strategic Plan science objectives.
  Indicator
  Meet no fewer than 75% of the development performance objectives for "major programs/projects," supported by completion of performance objectives in majority of "other projects."
  Major Programs/Projects:
  - Hubble Space Telescope (HST) Development: Begin system test of the Cosmic Origins Spectrograph (COS).
  - Hubble Space Telescope (HST) Development: Advanced Camera for Surveys (ACS) and Solar Array 3 (SA3) will be ready for flight and installation on Servicing Mission 3B.
  - Space Infrared Telescope Facility (SIRTF) Development: Complete integration and test (I&T) of spacecraft and payload.
  - Stratospheric Observatory for Infrared Astronomy (SOFIA) Development: Complete installation of the forward pressure bulkhead.
  - Gravity Probe-B (GP-B) Development: Initiate flight vehicle integration and test (I&T).
  - Mars Exploration Rover '03 Development: Initiate assembly, test and launch operations (ATLO) process.
  - Mars Reconnaissance Orbiter '05 Development: Select payload and initiate development.
  - Solar Terrestrial Relations Observatory (STEREO) Development: Have contracts in place for start of spacecraft and instrument detailed design and fabrication.

  Other Projects:
  - Swift Gamma Ray Burst Explorer (Swift) Development: Complete build-up of spacecraft subsystems.
  - Full-sky Astrometric Mapping Explorer (FAME) Development: Conduct Confirmation Review.
  - Galaxy Evolution Explorer (GALEX) Development: Complete environmental testing.
  - Comet Nucleus Tour (CONTOUR) Development: Complete environmental testing.
  - Mercury Surface, Space Environment, Geochemistry and Ranging (MESSENGER) Mission Development: Conduct Critical Design Review (CDR).
  - Solar-B Development: Conduct the Pre-Environmental Review for the U.S.-provided Extreme Ultraviolet Imaging Spectrometer (EIS).
  - Planck Development: Complete the High-Frequency Instrument (HFI) flight detectors.

Strategic Plan Goal:
Technology/Long-Term Future Investments: **Develop new technologies to enable innovative and less expensive research and flight missions.**

Objectives: Acquire new technical approaches and capabilities. Validate new technologies in space. Apply and transfer technology.

Public Benefit: NASA must be a prudent steward of the taxpayers' money by investing in essential technologies that are clearly relevant to future missions. This important principle includes consideration of the possibilities for commercialization, as well as options for using key technologies for multiple missions.

APG 2S10: Earn external review rating of "green" on making progress in the following technology development area:

- Focus technology development on a well-defined set of performance requirements covering the needs of near-term to mid-term strategic plan missions.

  Indicator

  Meet no fewer than 66% of the performance objectives for technology development.
  - Next Generation Space Telescope (NGST): Downselect to single Phase II prime contractor.
  - Space Interferometry Mission (SIM): Use the Microarcsecond Metrology (MAM-1) Testbed to demonstrate metrology at the 200-picometer level with white light fringe measurements. (Accomplishing this level of performance is required in order for SIM to identify multi-planet solar systems out to 10 parsecs.)
  - Terrestrial Planet Finder (TPF): Provide studies and integrated models of mission architecture concepts.
  - Gamma-ray Large Area Space Telescope (GLAST): Conduct Large Area Telescope Preliminary Design Review (PDR).
  - Herschel Space Observatory: Complete the SPIRE qualification model detectors.
  - StarLight: Conduct Preliminary Design Review (PDR).
  - Outer Planets Program: Complete evaluation and restructuring of Outer Planets Program.
  - In-Space Propulsion: Compete and select Phase I award(s) for electric propulsion technology development.
  - Living With a Star: Announce instrument investigations for Solar Dynamics Observatory (SDO) mission.

Public Benefit: Careful stewardship of public money requires that challenging new technologies be evaluated via cost-effective demonstration and precursor missions so that NASA's most ambitious research facilities can be reliably developed using proven technologies.

APG 2S11: Earn external review rating of "green" on making progress in the following technology validation area:

- Formulate and implement cost-effective space demonstrations of selected technologies on suitable carriers.

  Indicator

  Meet no fewer than 66% of the performance objectives for flight validation.
  - Flight Validation/New Millennium Program: Conduct Space Technology 6 (ST-6) Confirmation Review.
  - Flight Validation/New Millennium Program: Conduct New Millennium Carrier-1 (NMC-1) Confirmation Review.
  - Flight Validation/New Millennium Program: Conduct Space Technology 5 (ST-5) Critical Design Review (CDR).

Strategic Plan Goal:

Education and Public Outreach: **Share the excitement and knowledge generated by scientific discovery and improve science education.**

Objectives: Share the excitement of space science discoveries with the public. Enhance the quality of science, mathematics, and technology education, particularly at the pre-college level. Help create our 21st Century scientific and technical workforce.

Public Benefit: Space Science Enterprise education and public outreach goals center on sharing the results of our missions and research programs with wide audiences and using space science discoveries as vehicles to improve teaching and learning at all levels. This is a deliberate expansion of the traditional role of the Enterprise in supporting graduate and postgraduate professional education, a central element of meeting our responsibility to help create the scientific workforce of the future. Our commitment to education includes a special emphasis on pre-college education and on increasing the general public's understanding and appreciation of science, mathematics, and technology.

APG 2S12: Earn external review rating of "green," on average, on making progress in the following focus areas:

- Incorporate a substantial, funded education and outreach program into every space science flight mission and research program.
- Increase the fraction of the space science community that contributes to a broad public understanding of science and is directly involved in education at the pre-college level.
- Establish strong and lasting partnerships between the space science and education communities.
- Develop a national network to identify high-leverage education and outreach opportunities and to support long-term partnerships.
- Provide ready access to the products of space science education and outreach programs.
- Promote the participation of underserved and underutilized groups in the space science program by providing new opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs.
- Develop tools for evaluating the quality and impact of space science education and outreach programs.

Indicator

Meet no fewer than six (75%) of the eight performance objectives for education and public outreach (E/PO).

- Ensure that every mission initiated in FY 2002 has a funded E/PO program, with a comprehensive E/PO plan prepared by its Critical Design Review (CDR).
- Establish a baseline for the number of space scientists who are participating in E/PO activities. This baseline will be used in the future to track success in increasing the fraction of the space science community that is directly involved in pre- college education and is contributing to a broad public understanding of science.
- Plan and/or implement Enterprise-funded E/PO activities taking place in at least forty states.
- Ensure that at least ten Enterprise-sponsored research, mission development or operations, or education projects are underway in Historically Black Colleges and Universities, Hispanic Serving Institutions, and Tribal Colleges, with at least three being underway in an institution of each type.
- Provide exhibits, materials, workshops, and personnel at a minimum of five national and three regional education and outreach conferences.
- Ensure that at least eight major Enterprise-sponsored exhibits or planetarium shows will be on display or on tour at major science museums or planetariums across the country.
- Prepare the second comprehensive Space Science Education/Outreach Report describing participants, audiences, and products for Enterprise E/PO programs.
- Initiate a major external review of the accomplishments of the Space Science E/PO efforts over the past five years, and complete a pilot study directed towards the eventual development of a comprehensive approach to assessing the

E/PO program's long-term effectiveness and educational impact. Use the preliminary results of both studies to guide adjustments in program direction and content.

VERIFICATION AND VALIDATION

Internal Assessment and Verification

The Space Science program consists of numerous diverse components, and each component's performance must be assessed in an appropriate way. For some program elements, such as mission and technology development, achievement of major milestones can be assessed through routine project management reviews. For missions in an operational phase, success can be gauged in terms of operating efficiency or major data sets returned. In each of these cases, performance assessment data is retrieved from normal project management reporting during the course of the fiscal year, and is verified and validated by the cognizant Program Executive or Program Scientist.

External Assessment and Verification

For the basic research programs, evaluation must consider important contextual factors such as: the relative value of the research objectives; progress toward those objectives; productivity by prevailing research community standards; and impact on related research funded or performed by other agencies. Measures such as number of grants or scientists supported, publication counts, or research citations are not able to capture these important aspects of the evaluation requirement. The best way to assess research programs has been demonstrated to be an external peer review approach. The Enterprise will employ this mechanism to qualitatively assess the progress of its programs in basic research and data analysis against Enterprise strategic plan science goals and objectives. The reviews will determine whether outcomes of these programs are fully effective, are not as strong as desired but have returned results of significant value, or are not scientifically or technologically competitive. The review process will also identify those programs that have produced important unexpected results or have contributed to an unanticipated degree to other research.

External Validation

At the conclusion of the assessment and verification process, the performance results will be reviewed and validated by the NASA Advisory Council.

MULTI-YEAR PERFORMANCE TREND

Space Science Enterprise (SSE)

Solve mysteries of the universe.

	FY 1999	**FY 2000**	**FY 2001**	**FY 2002**
Annual Performance Goal and APG #	9S1: Successfully launch seven spacecraft, within 10% of budget, on average.			
Assessment	Blue			
Annual Performance Goal and APG #	9S2: Measure the Hubble constant within an accuracy of about 10 percent, as compared to previous measurements that differ among themselves by a factor of two. (R&A)			
Assessment	Green			
Annual Performance Goal and APG #	9S3:Record 25 images and spectra at a resolution of better than an arcsecond, five to ten times sharper than images gathered earlier by the Einstein Observatory (CXO)	OS1: The Chandra X-ray Observatory (formerly AXAF) instrument will meet nominal performance expectations, and science data will be taken with 70% efficiency, with at least 90% of science data recovered on the ground.		
Assessment	Green	Green		

Solve mysteries of the universe.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9S4: Record data on approximately 12 compact stellar objects with a sensitivity 50 times greater than the Einstein Observatory.(CXO)			
Assessment	Green			
Annual Performance Goal and APG #	9S5: Observe physical phenomena 25,000 times closer to the event horizon of black holes than permitted with optical wavelength measurements. (RXTE)	OS2:The baseline RXTE mission ended in 1997; the target for FY00 is to operate at least three of the five instruments at an efficiency of 45%, with 95% data recovery; All Sky Monitor data will be posted on the web within 7 days, and Proportional Counter Array and High-Energy X-ray Timing Experiment data will be released within 60 days.		
Assessment	Green	Green		
Annual Performance Goal and APG #		OS3: Complete final integration and test of the Gravity Probe-B science payload with the spacecraft in August 2000.		
Assessment		Yellow		

Solve mysteries of the universe.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		OS4: Successfully install and activate three key Hubble upgrades during the third servicing mission: flight computer, advanced camera, and solar arrays. Maintain an average on-target pointing efficiency of 35% during FY00 operations before they are interrupted for the third servicing mission, presently scheduled for May 2000.		
Assessment		Yellow		
Annual Performance Goal and APG #		OS43: Complete the SOFIA 747 Section 46 mockup test activity during June 2000, with no functional test discrepancies that would invalidate CDR-level designs and cause significant design rework, with attendant cost and schedule impact.		
Assessment		Green		

Solve mysteries of the universe.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S5: Deliver the SIRTF Infrared Array Camera (IRAC), Multiband Imaging Photometer (MIPS), and Infrared Spectrograph (IRS) instruments during April 2000. The instruments shall perform at their specified levels at delivery.		
Assessment		Yellow		
Annual Performance Goal and APG #		0S6: Prepare the INTEGRAL Science Data Center (ISDC) for data archiving and prepare instrument analysis software for the spectrometer on INTEGRAL (SPI) instrument within 10% of estimated cost.		
Assessment		Green		
Annual Performance Goal and APG #		0S7:Assemble and successfully test the breadboard cooler for ESA's Planck mission in April 2000.		
Assessment		Yellow		

Solve mysteries of the universe.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S8: Deliver the GALEX science instrument from JPL to the Space Astrophysics Laboratory at Caltech during April 2000 for science calibration. The instrument will be fully integrated, functionally tested, and environmentally qualified at the time of the scheduled delivery.		
Assessment		Yellow		
Annual Performance Goal and APG #		0S9: Begin system-level environmental testing of the MAP spacecraft during July 2000.		
Assessment		Green		
Annual Performance Goal and APG #		0S11:The baseline mission of the CGRO ended in 1996; the target for FY00 is to continue to operate those instruments not dependent on expended consumables (Oriented Scintillation Spectrometer Experiment, OSSE; Burst and Transient Source Experiment, BATSE; and Imaging Compton Telescope, COMPTEL) at an average efficiency of at least 60%.		
Assessment		Green		

Solve mysteries of the universe.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S12: The 3-year FUSE mission will complete at least one-third of the observations needed for its minimum science program, with six of the eight instrument performance parameters being met.		
Assessment		Green		
Annual Performance Goal and APG #		0S15: The prime mission of SAMPEX ended in 1995; the FY00 target is to obtain at least 60% data coverage from at least three of SAMPEX's four instruments.		
Assessment		Green		
Annual Performance Goal and APG #		0S14: If launched, activate the XRS and XIS instruments on the Japanese Astro-E spacecraft after launch and collect at least 90% of the XRS and XIS data.		
Assessment		Red		

Solve mysteries of the universe.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S53: Complete the NGST Developmental Cryogenic Active Telescope Testbed (DCATT) phase 1, measure ambient operation with off-the-shelf components, and make final preparations for phase 2, the measurement of cold telescope operation with selected "flight-like" component upgrades.		
Assessment		Red		
Annual Performance Goal and APG #		0S62: Demonstrate performance of the Superconductor-Insulator-Superconductor (SIS) mixer to at least 8hv/k at 1,120 GHz and 10hv/k at 1,200 GHz. The U.S. contribution to the ESA FIRST is the heterodyne instrument, which contains the SIS receiver.		
Assessment		Yellow		
Annual Performance Goal and APG #		0S63: The prototype primary instrument for GLAST will demonstrate achievement of the established instrument performance level of angular resolution of 3.5 degrees across the entire 20-MeV to 100-GeV energy range.		
Assessment		Green		

Solve mysteries of the universe.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S65: Based on an overall goal of successfully launching 25 sounding rocket missions, at least 23 payloads shall successfully achieve their required altitude and orientation, and at least 21 investigators shall achieve their minimum mission success goals.		
Assessment		Red		
Annual Performance Goal and APG #		0S66: Based on an overall goal of conducting 26 worldwide science and technology demonstration balloon missions, at least 23 campaigns shall successfully achieve altitude and distance, and investigators' instrumentation shall function as planned for at least 19 missions.		
Assessment		Red		
Annual Performance Goal and APG #			1S1: Successfully develop and launch no fewer than three of four planned missions within 10% of budget and schedule. Missions are: GALEX, MAP, GP-B, and CATSAT. (Indicators have also been established for other missions in development.)	
Assessment			TBD	

Solve mysteries of the universe.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #			1S2: Obtain expected scientific data from at least 80% of operating missions. Missions are: HST, CXO, XTE, ACE, FUSE, SWAS, and, if successfully launched, GALEX, and GP-B.	
Assessment			TBD	
Annual Performance Goal and APG #			1S3: Perform innovative scientific research and technology development by meeting technology development objectives for major projects, by achieving mission success in astronomy rocket and balloon flights, and by making satisfactory research progress in related Research and Analysis (R&A) and Data Analysis (DA) programs. Meet no fewer than 66% of the performance objectives for the following technology and research programs NGST, Herschel (FIRST), GLAST, Sounding Rockets, Balloons, and R&A. Achieve a "fully effective" (green) overall science achievement rating	

			from the Space Science external advisory committee. (#1S3)	
Assessment			TBD	

Understand the structure of the Universe, from its earliest beginnings to its ultimate fate.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				2S1: Earn external review rating of "green," on average, on making progress in the following research focus areas: • Identify dark matter and learn how it shapes galaxies and systems of galaxies. • Determine the size, shape, age, and energy content of the universe.
Assessment				TBD

Explore the ultimate limits of gravity and energy in the Universe.

Annual Performance Goal and APG #				2S2: Earn external review rating of "green," on average, on making progress in the following research focus areas: • Discover the sources of gamma ray bursts and high-energy cosmic rays. • Test the general theory of relativity near black holes and in the early universe, and search for new physical laws using the universe as a

				laboratory. • Reveal the nature of cosmic jets and relativistic flows.
Assessment				TBD

Learn how galaxies, stars, and planets form, interact, and evolve.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				2S3: Earn external review rating of "green," on average, on making progress in the following research focus areas: • Observe the formation of galaxies and determine the role of gravity in this process. • Establish how the evolution of a galaxy and the life cycle of stars influence the chemical composition of material available for making stars, planets, and living organisms. • Observe the formation of planetary systems and characterize their properties. • Use the exotic space environments within our Solar System as natural science laboratories and cross the outer boundary of the Solar System to explore the nearby environment of our

				galaxy.
Assessment				TBD

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9S6: Orbit Eros closer than 50 kilometers, 20-30 times closer than previous asteroid flybys. (NEAR)	0S16: NEAR will successfully orbit 433 Eros and meet primary scientific objectives while not exceeding projected mission cost by more than 10%.		
Assessment	Yellow	Green		
Annual Performance Goal and APG #	9S7: Measure the shape of Eros to an accuracy of 1 kilometer or better, about 10 times better than previous measurements, and measure the asteroid's mass to an accuracy of 20 percent. (NEAR)			
Assessment	Green			
Annual Performance Goal and APG #	9S8: Complete the first direct compositional measurements of an asteroid. (NEAR)			
Assessment	Yellow			
Annual Performance Goal and APG #	9S9: Map the 75 to 80 percent of the Moon's surface not accessible during the Apollo missions conducted from 1969 to 1972. (Lunar Prospector)			
Assessment	Green			

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9S10:Provide definitive measurements of the weak lunar magnetic field. (Lunar Prospector)			
Assessment	Green			
Annual Performance Goal and APG #	9S11: Provide these data with spatial resolution five times better than were collected from the Yohkoh Soft X-ray Telescope. (TRACE)	0S17: Collect pixel-limited images in all Transition Region and Coronal Explorer (TRACE) wavelength bands, operating 24-hour schedules for sustained periods over eight months.		
Assessment	Green	Green		
Annual Performance Goal and APG #		0S29: Deliver the Mars '01 Orbiter and Lander science instruments that meet capability requirements by June 1, 2000; prelaunch Gamma Ray Spectrometer (GRS) tests shall determine abundances in known calibration sources to 10% accuracy.		
Assessment		Yellow		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S30: Assuming the Mars Surveyor program architecture is confirmed, meet the milestones for the Mars 03 instrument selection and initiate implementation of the Lander mission. Deliver engineering models of the radio-frequency subsystem and antennae for the radar sounder instrument to ESA (if ESA approves the Mars Express mission), and select the contractors for the major system elements of the Mars Surveyor 05 mission.		
Assessment		Yellow		
Annual Performance Goal and APG #		0S20: The Rosetta project will deliver the electrical qualification models for the four U.S.-provided instruments to ESA in May 2000 for integration with the Rosetta Orbiter.		
Assessment		Green		
Annual Performance Goal and APG #		0S18: The TIMED mission will be delivered on time for a planned May 2000 launch, within 10% of the planned development budget.		
Assessment		Yellow		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S19:If successfully launched, the TIMED mission will acquire global data in the mesosphere and lower thermosphere/ionosphere region globally (all the latitudes) for at least 90 days at the required spatial resolution, coverage, and accuracy and for all local solar times.		
Assessment		Yellow		
Annual Performance Goal and APG #		0S21: Complete the development of the Cluster-II instrument analysis software for the one U.S. and five U.S.-partnered instruments before launch and, if launch occurs in FY00, activate and verify the wideband data and U.S. sub-components after launch.		
Assessment		Green		
Annual Performance Goal and APG #		0S22: HESSI will be delivered in time for a planned July 2000 launch, within 10% of the planned development budget.		
Assessment		Yellow		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S23:Assuming launch and normal checkout, HESSI operations will return data to achieve at least the primary science objectives, with at least 80% coverage of the time allowed by orbit.		
Assessment		Yellow		
Annual Performance Goal and APG #		0S25: Deliver to the Los Alamos National Laboratory in March 2000 all components for system integration and testing of the first flight system for the TWINS mission.		
Assessment		Green		
Annual Performance Goal and APG #		0S26: IMAGE will be delivered on time for a planned February 2000 launch and within 10% of the planned development budget.		
Assessment		Green		
Annual Performance Goal and APG #		0S27: If launched, IMAGE will acquire critical measurements at minute time scales, returning 85% real-time coverage of Earth's magnetospheric changes.		
Assessment		Green		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S28: Select two Small Explorer (SMEX) missions and release a University Explorer (UNEX) Announcement of Opportunity (AO).		
Assessment		Red		
Annual Performance Goal and APG #		0S24: Acquire calibrated observational data from the Japanese Yohkoh high-energy solar physics mission (including the U.S.-provided SXT) for at least 75% of the time permitted by tracking coverage.		
Assessment		Green		
Annual Performance Goal and APG #		0S31: Complete Genesis spacecraft assembly and start functional testing in November 1999.		
Assessment		Green		
Annual Performance Goal and APG #		0S32: Release an AO for the next Discovery mission.		
Assessment		Green		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S42: Successfully complete the breadboard of the imager instrument for CONTOUR and award the contract for the propulsion system after a PDR that confirms the design and maintains 15% margins for mass and power.		
Assessment		Green		
Annual Performance Goal and APG #		0S45: The baseline Galileo mission ended in 1997; the target for FY00 is to recover at least 90% of playback data from at least one Galileo flyby of Io. *(also shown below, under "Search for Life Beyond Earth")*		
Assessment		Blue		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S40: The Mars Climate Orbiter (MCO) will aerobrake from its initial insertion orbit into a near-polar, Sun-synchronous, approximately 400-km circular orbit and will initiate mapping operations no later than May 2000, acquiring 70% of the available science data and relaying to Earth 70% of the data transmitted at adequate signal levels by the Mars Polar Lander (MPL).		
Assessment		Red		
Annual Performance Goal and APG #		0S41: MPL will successfully land on Mars in December 1999 and operate its science instruments for the 80-day prime mission with at least 75% of planned science data returned.		
Assessment		Red		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S46: The Mars Global Surveyor (MGS) will acquire 70% of science data available, conduct at least two five-day atmospheric mapping campaigns, and relay to Earth at least 70% of data transmitted at adequate signal levels by the Deep Space-2 Mars microprobes. *(also shown below, under "Mars, the Moon, and small bodies")*		
Assessment		Green		
Annual Performance Goal and APG #		0S33: Collect 85% of data acquired from the International Solar-Terrestrial Physics Program (ISTP) spacecraft and successfully execute the WIND trajectory plan.		
Assessment		Green		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		Cassini: Continue operations during the quiescent cruise phase without major anomalies, conduct planning for the Jupiter gravity-assist flyby, and explore early science data collection opportunities. The following in-flight activities will be completed: Instrument Checkout #2; uplink Articulation and Attitude Control Subsystem (AACS) software update with Reaction Wheel Authority capability; Command and Data Subsystem Version 8; and Saturn tour designs for selection by the Program Science Group. #OS34		
Assessment		Green		
Annual Performance Goal and APG #		0S35: Capture at least 90% of available Ulysses science data. These will be the only data observed from outside-of-the-ecliptic plane.		
Assessment		Green		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		Average 12 hours of Voyager Interstellar Mission data capture per day per spacecraft to characterize the heliosphere and the heliospheric processes at work in the outer solar system as well as the transition from the solar system to interstellar space. #OS36		
Assessment		Yellow		
Annual Performance Goal and APG #		0S37: Stardust: Continue spacecraft cruise operations without major anomalies and perform interstellar dust collection for at least 36 days.		
Assessment		Green		
Annual Performance Goal and APG #		0S38: FAST will return simultaneous data from high-latitude, low-altitude magnetosphere locations in the Sun-Earth connected system through solar maximum at the required resolution and accuracy with at least 85% efficiency.		
Assessment		Green		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S39: Collect and process data from the Interplanetary Monitoring Platform (IMP-8, launched in 1973), making data from at least six instruments available within 15 months and the magnetic field and plasma data available within 2 months.		
Assessment		Green		
Annual Performance Goal and APG #		0S48: ACE will measure the composition and energy spectra of heavy nuclei in at least eight solar energetic particle events; maintain real-time solar wind data transmissions at least 90% of the time; measure the isotopic composition of a majority of the "primary" galactic cosmic ray elements from carbon to zinc; and provide browse parameters within three days for 90% of the year.		
Assessment		Green		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S47: Complete the system CDR for the New Millennium Deep Space-4 (Champollion) project before the end of FY00, including successful completion of the avionics subsystem CDR and the mechanical subsystem CDR.		
Assessment		Red		
Annual Performance Goal and APG #		0S58: The Advanced Radioactive Power Source (ARPS), which is a partnership with the Department of Energy to develop small, robust, highly efficient radioisotope power sources, will accomplish the following five objectives on time and within budget in 2000: fabricate and test 15 prototype AMTEC cells by January; complete the final design of the AMTEC cells by March; complete the final design for a 75-watt ARPS by April; begin the prototype AMTEC four-cell lifetime test by April; and begin qualification unit fabrication by September.		
Assessment		Red		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S60: Complete and deliver for testing Solar-B's four Electrical Engineering Models in September 2000.		
Assessment		Yellow		
Annual Performance Goal and APG #		0S61: Complete STEREO Phase A studies by June 2000, including the release of an AO for investigations with specific instruments and selection of the formulation phase payload.		
Assessment		Yellow		
Annual Performance Goal and APG #		0S64: Successfully complete a preliminary design for either the Europa Orbiter or Pluto-Kuiper Express mission (whichever is planned for earlier launch) that is shown to be capable of achieving the Category 1A science objectives with adequate cost, mass, power, and other engineering margins.		
Assessment		Red		

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S70: The first engineering model (EM-1) of the X2000 First Delivery will be delivered in September 2000. Successful development includes the integration of all EM-1 hardware, the functional verification of delivered hardware and software, and the ability to support ongoing testing, hardware integration, and software verification for delivered software.		
Assessment		Red		
Annual Performance Goal and APG #			1S4: Successfully develop and launch no fewer than one of two missions within 10% of budget and schedule. Missions are: Mars Odyssey ('01 Orbiter) and Genesis. (Indicators have also been established for other projects in development.)	
Assessment			TBD	

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #			1S5: Obtain expected scientific data from at least 80% of operating missions. Missions are: Cassini, Voyager, Ulysses, SAMPEX, FAST, TRACE, Stardust, Mars Global Surveyor, and ISTP spacecraft; also, if successfully launched, TIMED, HESSI, IMAGE, Genesis, and Mars Odyssey ('01 Orbiter).	
Assessment			TBD	

Explore the solar system.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #			1S6: Perform innovative scientific research and technology development by meeting technology development objectives for major projects, by achieving mission success in space physics rocket and balloon flights, and by making satisfactory research progress in related R&A and DA programs. Meet no fewer than 66% of the performance objectives for the following technology and research programs Solar-B, STEREO, Solar Probe, Future Solar Terrestrial Probes, Future Deep Space Technology, CISM, X2000, Sounding Rockets, and Balloons. Achieve a "fully effective" (green) overall science achievement rating from the Space Science external advisory committee.	
APG Assessment				

Understand the formation and evolution of the Solar System and the Earth within it.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				2S5: Earn external review rating of "green," on average, on making progress in the following research focus areas: • Inventory and characterize the remnants of the original material from which the Solar System formed. • Learn why the planets in our Solar System are so different from each other. • Learn how the Solar System evolves.
Assessment				TBD

Probe the evolution of life on Earth, and determine if life exists elsewhere in our Solar System.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				2S6: Earn external review rating of "green," on average, on making progress in the following research focus areas: • Investigate the origin and early evolution of life on Earth, and explore the limits of life in terrestrial environments that might provide analogues for conditions on other worlds. • Determine the general principles governing the organization of matter into living systems and the conditions required for the emergence and maintenance of life • Chart the distribution of life-sustaining environments within our Solar System, and search for evidence of past and present life. • Identify plausible signatures of life on other worlds.
Assessment				TBD

Understand our changing Sun and its effects throughout the Solar System.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				2S7: Earn external review rating of "green," on average, on making progress in the following research focus areas: • Understand the origins of long- and short-term solar variability. • Understand the effects of solar variability on the solar atmosphere and heliosphere. • Understand the space environment of Earth and other planets.
Assessment				TBD

Chart our destiny in the Solar System.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				2S8: Earn external review rating of "green," on average, on making progress in the following research focus areas: • Understand forces and processes, such as impacts, that affect habitability of Earth. • Develop the capability to predict space weather. • Find extraterrestrial resources and assess the suitability of Solar System locales for future human exploration.
Assessment				

Discover planets around other stars.

Annual Performance Goal and APG #	9S12:Assemble and lab-test the interferometer beam combiner. This state-of-the-art system will approximately double observational efficiency by using a new approach to fringe detection. (Keck)	0S55: Development of the interferometer program for connecting the twin Keck 10-meter telescopes with an array of four two-meter class outrigger telescopes will be tested by detecting and tracking fringes with two test siderostats at two- and ten-micron wave		
Assessment	Green	Yellow		

Discover planets around other stars.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S52: The Space Interferometry Mission (SIM) System Testbed (STB) will demonstrate, in May 2000, that an rms optical path difference can be controlled at 1.5 nanometers, operating in an emulated on-orbit mode.		
Assessment		Green		
Annual Performance Goal and APG #		0S54: Complete and deliver a technology development plan for the Terrestrial Planet Finder (TPF) mission by June 2000. This infrared interferometer mission is projected for a 2010 launch and requires the definition of technologies that will not be developed or demonstrated by precursor missions.		
Assessment		Red		

Discover planets around other stars.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #			1S7: Perform innovative scientific research and technology development by meeting interferometry technology development objectives and by making satisfactory research progress in related R&A programs. Meet no fewer than 66% of the performance objectives for SIM, TPF, ST-3, Keck, and R&A. Achieve a "fully effective" (green) overall science achievement rating from the Space Science external advisory committee.	
Assessment			TBD	

Look for signs of life in other planetary systems.

Annual Performance Goal and APG #				2S4: Earn external review rating of "green," on average, on making progress in the following research focus areas: • Discover planetary systems of other stars and their physical characteristics. • Search for worlds that could or do harbor life.
Assessment				

Search for life beyond Earth.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9S13: Successfully complete and receive scientific data from at least 8 of 10 planned data-taking encounters with Europa. (Galileo)			
Assessment	Green			
Annual Performance Goal and APG #	9S14: Bring the total mapping coverage to about 1 percent of the surface at about 30-meter resolution, and multispectral coverage distributed over 50 percent of the surface at lower resolution. (Galileo)			
Assessment	Green			
Annual Performance Goal and APG #	9S17: Initiate Institute operations by linking up to 8 institutions and engaging approximately 50 investigators. (Astrobiology Institute)			
Assessment	Green			
Annual Performance Goal and APG #		0S56:The Europa Orbiter project will successfully complete a PDR in March 2000 and will begin the integration and test of the Avionics Engineering Model in July 2000.		
Assessment		Red		

Search for life beyond Earth.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #			1S8:Perform innovative scientific research and technology development by meeting technology development objectives and by making satisfactory research progress in the related R&A program, including the Astrobiology program. Meet no fewer than two of the three performance objectives for Europa Orbiter, Astrobiology, and R&A. Achieve a "fully effective" (green) overall science achievement rating from the Space Science external advisory committee.	
Assessment			TBD	
Annual Performance Goal and APG #			1S14: Advance the search for life beyond Earth by successfully launching a Mars mission, by obtaining data from operational spacecraft, and by performing innovative technology development. Meet no fewer than two of the three performance objectives for Mars Odyssey ('01 Orbiter), Mars Global Surveyor, and Terrestrial Planet Finder.	
Assessment			TBD	

Investigate the composition, evolution, and resources on Mars, the Moon, and small bodies.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9S15: Achieve the final science orbit. (MGS)			
Assessment	Green			
Annual Performance Goal and APG #	9S19: Measure the topography with 10-meter precision, about 100 times more accurate than previous measurements. (MGS)			
Assessment	Blue			
Annual Performance Goal and APG #	9S20: Provide high-resolution 1.5-meter imaging data, 10 times more detailed than the best imaging from the 1976 Viking mission. (MGS)			
Assessment	Green			
Annual Performance Goal and APG #	9S21: Provide the first thermal infrared spectrometry of the planet. (MGS)			
Assessment	Green			

Investigate the composition, evolution, and resources on Mars, the Moon, and small bodies.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #			1S10: Investigate the composition, evolution, and resources of Mars, the Moon, and small bodies by successfully launching a Mars mission, by obtaining data from operational spacecraft, and by making satisfactory progress in related R&A and DA programs. Meet no fewer than 75% of the performance objectives for Mars Odyssey ('01 Orbiter), CONTOUR, Mars Global Surveyor, and R&A. Achieve a "fully effective" (green) overall science achievement rating from the Space Science external advisory committee.	
Assessment			TBD	

Improve the reliability of space weather forecasting.

Annual Performance Goal and APG #	9S22: Achieve complete coverage (maximum and minimum) of the solar cycle, an increase from 35 percent. (Space Physics fleet of spacecraft)	*(Refer to Space Physics spacecraft targets under "Explore the Solar System.")*		
Assessment	Green			

Improve the reliability of space weather forecasting.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #			1S11: Develop the knowledge to improve the reliability of space weather forecasting by obtaining scientific data from three of five missions and by making satisfactory progress in related areas in R&A and DA programs. Meet no fewer than 75% of the performance objectives for R&A, ACE, SAMPEX, TRACE, ISTP, and, if successfully launched, HESSI. Achieve a "fully effective" (green) overall science achievement rating from the Space Science external advisory committee.	
Assessment			TBD	

Improve the reliability of space weather forecasting.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #			1S13: Further understanding of basic natural processes and the effects of solar variability on humans and technology. Meet no fewer than two of the three performance objectives for: Strategic Plan Development, Solar Dynamics Observatory, and Research and Data Analysis. Achieve a "fully effective' (green) overall science achievement rating from the Space Science external advisory committee.	
Assessment			TBD	
Annual Performance Goal and APG #	9S24: Demonstrate an improvement in measurement precision for optical path lengths in laser light to the 100-picometer (million-millionths of a meter) range. (Micro-Arcsecond Metrology Testbed)			
Assessment	Yellow			

Improve the reliability of space weather forecasting.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9S25: Demonstrate an advanced robotic manipulator with an order of magnitude performance improvement compared to the manipulator used on Viking in 1976. (Robotic Manipulator, Mars Polar Lander)			
Assessment	Green			
Annual Performance Goal and APG #		OS49: Information Systems R&T will demonstrate the search, discovery, and fusion of multiple data products at a major science meeting. Accomplish and document the infusion of five information systems R&T efforts into flight projects or the broad research community. Space science data services shall be acknowledged as enabling for two interdisciplinary collaborations.		
Assessment		Green		

Improve the reliability of space weather forecasting.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0S50: The Remote Exploration and Experimentation element of the HPCC program will demonstrate software-implemented fault tolerance for science teams' applications on a first-generation embedded computing testbed, with the applications' sustained performance degraded by no more than 25% at fault rates characteristic of deep space and low-Earth orbit.		
Assessment		Yellow		
Annual Performance Goal and APG #		In April 2000, the Center for Integrated Space Microelectronics will deliver to the X2000 First Delivery project the first engineering model of an integrated avionics system that includes the functionality of command and data handling, attitude control, power management and distribution, and science payload interface. The system will be used on the Europa Orbiter and other missions. #OS57		
Assessment		Red		

Develop new technologies needed to carry out innovative and less costly mission and research concepts.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #			1S12: Plan, develop, and validate new technologies needed to enable future research and flight missions by achieving performance objectives in the space science core technology programs and by making progress as planned in the Flight Validation program. Meet no fewer than 66% of the performance objectives for Information Systems, High Performance Computing, Explorer Program Technology, and Flight Validation.	
Assessment			TBD	

Acquire new technical approaches and capabilities. Validate new spacecraft capabilities in space. Apply and transfer technology.

Annual Performance Goal and APG #				2S10: Earn external review rating of "green" on making progress in the following technology development area: • Focus technology development on a well-defined set of performance requirements covering the needs of near-term to mid-term strategic plan missions.
Assessment				TBD

Acquire new technical approaches and capabilities. Validate new spacecraft capabilities in space. Apply and transfer technology.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				2S11: Earn external review rating of "green" on making progress in the following technology validation area: • Formulate and implement cost-effective space demonstrations of selected technologies on suitable carriers.
Assessment				TBD

Incorporate education and enhanced public understanding of science as integral components of space science missions and research.

Annual Performance Goal and APG #	9S26: Account for 4 percent of the 150 "most important science stories" in the annual review by *Science News*.			
Assessment	Green			
Annual Performance Goal and APG #	9S27: Account for no less than 25 percent of total contributions to the college textbook *Astronomy: From the Earth to the Universe*.			
Assessment	Green			
Annual Performance Goal and APG #	9S28: Each new Space Science Enterprise mission initiated in FY 1999 will have a funded education and outreach program.			
Assessment	Green			

Incorporate education and enhanced public understanding of science as integral components of space science missions and research.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9S29: The Space Science Enterprise will complete an organized network of contacts by the end of FY 1999 to work with educators and space scientists to formulate and implement space science education and outreach programs. This network will be available to every state in the United States.	0S67: Successful achievement of at least seven of the following eight objectives will be made. (1) Each new Space Science mission will have a funded education and outreach program. (2) By the end of FY00, 10% of all Space Science research grants will have an associated education and outreach program under way. (3) Twenty-six states will have Enterprise-funded education or outreach programs planned or underway. (4) At least five research, mission development/ operations, or education programs will have been planned/undertaken in Historically Black Colleges and Universities, Hispanic Serving Institutions, or Tribal Colleges, with at least one project underway in each group. (5) At least three national and two regional educational or outreach conferences will be supported with a significant Space Science presence. (6) At least three exhibits or		

		planetarium shows will be on display. (7) An online directory providing enhanced access to major Space Science-related products and programs will be operational by end of the fiscal year. (8) A comprehensive approach to assessing the effectiveness and impact of the Space Science education and outreach efforts will be under development, with a pilot test of the evaluation initiated.		
Assessment	Green	Green		

Make education and enhanced public understanding of science an integral part of our missions and research.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #			1S9: Continue and expand the integration of education and enhanced public understanding of science with Enterprise research and flight mission programs. Meet no fewer than 75% of the eight performance objectives for education and public outreach.	
Assessment			TBD	

Share the excitement of space science discoveries with the public. Enhance the quality of science, mathematics, and technology education, particularly at the pre-college level. Help create our 21st Century scientific and technical workforce.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				2S12: Earn external review rating of "green," on average, on making progress in the following focus areas: • Incorporate a substantial, funded education and outreach program into every space science flight mission and research program. • Increase the fraction of the space science community that contributes to a broad public understanding of science and is directly involved in education at the pre-college level. • Establish strong and lasting partnerships between the space science and education communities. • Develop a national network to identify high-leverage education and outreach opportunities and to support long-term partnerships. • Provide ready access to the products of space science education and outreach programs. • Promote the participation of underserved and

				underutilized groups in the space science program by providing new opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs. • Develop tools for evaluating the quality and impact of space science education and outreach programs.
Assessment				TBD

Multi-theme / support all objectives.

	FY 1999	**FY 2000**	**FY 2001**	**FY 2002**
Annual Performance Goal and APG #		0S68: Conduct research and analysis.		
Assessment		Green		
Annual Performance Goal and APG #		0S69: Conduct data analysis.		
Assessment		Green		

Support of Strategic Plan Science Objectives; Development/ Near-Term Future Investments (supports all objectives under the Science goal)

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				2S9: Earn external review rating of "green" on making progress in the following area: • Design, develop, and launch projects to support future research in pursuit of Strategic Plan science objectives.
Assessment				TBD

Space Science Enterprise FY 2002	Budget Category	SIRTF	HST Development	GP-B	SOFIA	STEREO	Payloads	Explorers	Discovery	Mars Surveyor	Operating Missions	SR&T
Annual Performance Goal & APG #												
2S1: Earn external review rating of "green," on average, on making progress in the following research focus areas: (1) Identify dark matter and learn how it shapes galaxies and systems of galaxies. (2) Determine the size, shape, age, and energy content of the universe.											X	X
2S2: Earn external review rating of "green," on average, on making progress in the following research focus areas: (1) Discover the sources of gamma ray bursts and high energy cosmic rays. (2) Test the general theory of relativity near black holes and in the early universe, and search for new physical laws using the universe as a laboratory. (3) Reveal the nature of cosmic jets and relativistic flows.											X	X
2S3: Earn external review rating of "green," on average, on making progress in the following research focus areas: (1) Observe the formation of galaxies and determine the role of gravity in this process. (2) Establish how the evolution of a galaxy and the life cycle of stars influence the chemical composition of material available for making stars, planets, and living organisms. (3) Observe the formation of planetary systems and characterize their properties. (4) Use the exotic space environments within our Solar System as natural science laboratories and cross the outer boundary of the Solar System to explore the nearby environment of our galaxy.											X	X

Space Science Enterprise FY 2002	Budget Category	SIRTF	HST Development	GP-B	SOFIA	STEREO	Payloads	Explorers	Discovery	Mars Surveyor	Operating Missions	SR&T
2S4: Earn external review rating of "green," on average, on making progress in the following research focus areas: (1) Discover planetary systems of other stars and their physical characteristics. (2) Search for worlds that could or do harbor life.											X	X
2S5: Earn external review rating of "green," on average, on making progress in the following research focus areas: (1) Inventory and characterize the remnants of the original material from which the Solar System formed. (2) Learn why the planets in our Solar System are so different from each other. (3) Learn how the Solar System evolves.											X	X
2S6: Earn external review rating of "green," on average, on making progress in the following research focus areas: (1) Investigate the origin and early evolution of life on Earth, and explore the limits of life in terrestrial environments that might provide analogues for conditions on other worlds. (2) Determine the general principles governing the organization of matter into living systems and the conditions required for the emergence and maintenance of life. (3) Chart the distribution of life-sustaining environments within our Solar System, and search for evidence of past and present life. (4) Identify plausible signatures of life on other worlds.											X	X

Space Science Enterprise FY 2002	Budget Category	SIRTF	HST Development	GP-B	SOFIA	STEREO	Payloads	Explorers	Discovery	Mars Surveyor	Operating Missions	SR&T
2S7: Earn external review rating of "green," on average, on making progress in the following research focus areas: (1) Understand the origins of long- and short-term solar variability. (2) Understand the effects of solar variability on the solar atmosphere and heliosphere. (3) Understand the space environment of Earth and other planets.											X	X
2S8: Earn external review rating of "green," on average, on making progress in the following research focus areas: (1) Understand forces and processes, such as impacts, that affect habitability of Earth. (2) Develop the capability to predict space weather. (3) Find extraterrestrial resources and assess the suitability of Solar System locales for future human exploration.											X	X
2S9: Earn external review rating of "green" on making progress in the following area: Design, develop, and launch projects to support future research in pursuit of Strategic Plan science objectives.		X	X	X	X	X	X	X	X	X		
2S10: Earn external review rating of "green" on making progress in the following technology development area: Focus technology development on a well-defined set of performance requirements covering the needs of near-term to mid-term strategic plan missions.												X

Space Science Enterprise FY 2002	Budget Category	SIRTF	HST Development	GP-B	SOFIA	STEREO	Payloads	Explorers	Discovery	Mars Surveyor	Operating Missions	SR&T
2S11: Earn external review rating of “green” on making progress in the following technology validation area: Formulate and implement cost-effective space demonstrations of selected technologies on suitable carriers.												X
2S12: 'Earn external review rating of “green,” on average, on making progress in the following focus areas: (1) Incorporate a substantial, funded education and outreach program into every space science flight mission and research program. (2) Increase the fraction of the space science community that contributes to a broad public understanding of science and is directly involved in education at the pre-college level. (3) Establish strong and lasting partnerships between the space science and education communities. (4) Develop a national network to identify high-leverage education and outreach opportunities and to support long-term partnerships. (5) Provide ready access to the products of space science education and outreach programs. (6) Promote the participation of underserved and underutilized groups in the space science program by providing new opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs. (7) Develop tools for evaluating the quality and impact of space science education and outreach programs.		X	X	X	X	X	X	X	X	X	X	X

Earth Science Enterprise (ESE)

Mission

The mission of NASA's Earth Science Enterprise (ESE) is to develop a scientific understanding of the Earth system and its response to natural and human-induced changes to enable improved prediction of climate, weather, and natural hazards for present and future generations. NASA brings to this endeavor the vantage point of space, allowing global views of Earth system change. NASA is a provider of objective scientific information, via observation, research, modeling, and applications demonstration, for use by decision-makers in both the public and private sectors. NASA has been studying the Earth from space from its beginnings as an agency. These efforts have led to our current activity of deploying the first series of Earth Observing System satellites that will concurrently observe the major interactions of the land, oceans, atmosphere, ice, and life that comprise the Earth system.

We know that natural and human-induced changes are acting on the Earth system. Natural forces include variation in the Sun's energy output, and volcanic eruptions, which spew dust into the atmosphere and scatter incoming sunlight. Human forces include deforestation, carbon emission from burning of fossil fuels, methane and soil dust production from agriculture, and ozone depletion by various industrial chemicals. Internal climate factors such as atmospheric water vapor and clouds also introduce feedbacks that serve to either dampen or enhance the strength of climate forcing. We also know the climate system exhibits considerable variability in time and space, i.e., both short and long term changes and regionally specific impacts.

NASA introduced the concept of Earth System Science. Researchers have constructed computer models to simulate the Earth system, and to explore the possible outcomes of potential changes they introduce in the models. This way of looking at the Earth as a system is a powerful means of understanding changes we see around us. That has two implications for Earth Science. First, we need to ***characterize*** (that is, identify and measure) the forces acting on the Earth system and its responses. Second, we have to peer inside the system to ***understand*** the source of internal variability: the complex interplay among components that comprise the system.

Earth system changes are global phenomena. Yet the system comprises many micro-scale processes, and the most significant manifestations are regional. Thus, studying such changes requires a global view at regionally discerning resolutions. This is where NASA comes in, bringing the unique capability to study planet Earth from the vantage point of space. By combining observations, research and modeling, we create a capability to ***predict*** Earth system change to help our partners produce better forecasts of change.

To ***characterize*** the forces acting on the Earth system and its responses, ***understand*** the source of internal variability and ***predict*** Earth system change, NASA must observe the Earth, conduct research and analysis of the data, model the data and synthesize the information into new knowledge. Where we are on this knowledge "life cycle" determines the strategy for our investment decisions.

Implementation Strategy

The ESE is pursuing a targeted research program, focused on a set of specific science questions that can be addressed effectively with NASA's capabilities. ESE formulates comprehensive research strategies that can lead to definitive scientific answers and to effective applications for the nation.

The key Earth Science research topics sponsored by NASA fall largely into three categories: forcings, responses, and the processes that link the two and provide feedback mechanisms. This conceptual approach applies in essence to all research areas of NASA's Earth Science program, although it is particularly relevant to the problem of climate change, a major Earth Science-related challenge facing our nation and the rest of the world. The ESE has articulated an overarching question and a set of strategic science questions which its observational programs, research and analysis, modeling, and advanced technology activities are directed at answering**.**

How is the Earth system changing, and what are the consequences for life on Earth?

How is the global Earth system changing?

What are the primary causes of change in the Earth system?

How does the Earth system respond to natural and human-induced changes?

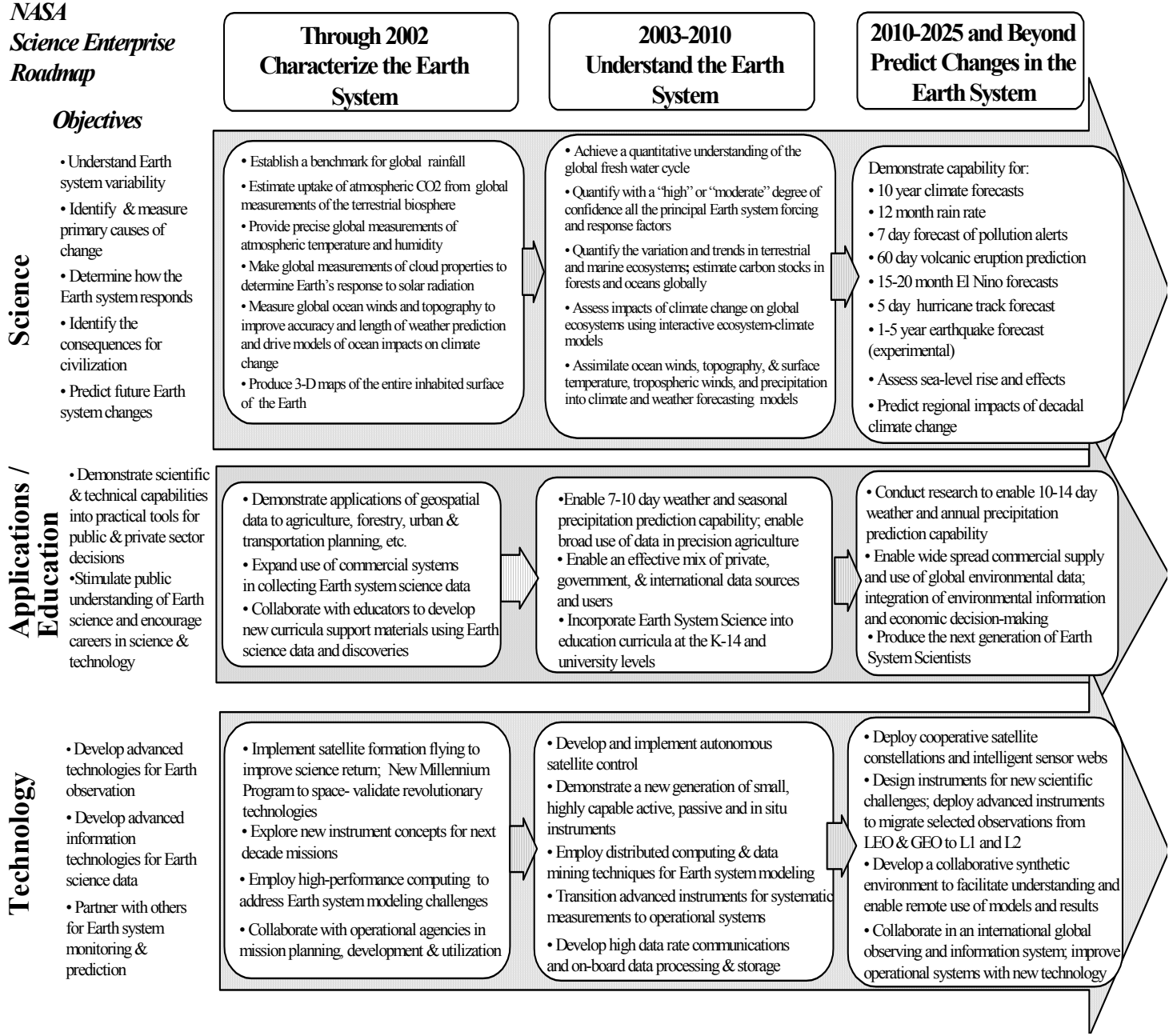
What are the consequences of changes in the Earth system for human civilization?

How can we predict future changes in the Earth system?

In this and subsequent Performance Plans, NASA's annual results in Earth Science will be measured in terms of progress made toward answering these questions. Accordingly, the assessment of performance against the first strategic goal is structured in the form of key questions whose answers are provided by the ongoing mission of NASA's Earth Science program. While these questions will be answered over a period greater than a single year, the general nature of activities in FY02 focuses on completion of the first EOS series and characterization of the forces acting on the Earth system and its responses.

Earth Science is science in the national interest. NASA is pleased to play a leadership role in exploring and understanding our home, Earth. This ESE Performance Plan describes our planned accomplishments toward this great endeavor in Fiscal Year 2002. These planned accomplishments, while important and useful in their own right, are essential stepping stones on the path to answering ESE's science questions over the next decade.

Figure 1. Strategic Roadmap for the Earth Science Enterprise



Resource Requirements

(NOA, dollars in millions)

	FY1999	FY 2000	FY 2001	FY 2002
$ M	1,413.8	1,443.4	1,485	1,626
Civil Service FTE	1,365	1,907	1,913	1,747

Performance Measures

Enterprise Mission: Develop a scientific understanding of the Earth system and its response to natural and human-induced changes to enable improved prediction of climate, weather, and natural hazards for present and future generations.

NASA's ESE is dedicated to understanding the total Earth system and the effects of natural and human-induced changes on the global environment. The vantage point of space provides information about Earth's land, atmosphere, ice, oceans and biota that is obtainable in no other way. Programs of the ESE study the interactions among these components to advance the new discipline of Earth System Science. Our research results contribute to the development of sound environmental policy and economic investment decisions**.**

NASA's ESE also develops innovative technologies and applications of remote sensing for solving practical societal problems in agriculture and food production, natural hazard mitigation, water resources, regional planning, and national resource management in partnership with other Federal agencies, with industry, and with state and local governments. Earth Science discoveries are shared with the public to enhance science, mathematics, and technology education and increase the scientific and technological literacy of all Americans. ESE combines the excitement of scientific discovery with the reward of practical contribution to the sustainability of planet Earth.

Strategic Goal (I): Observe, understand, and model the Earth system to learn how it is changing, and the consequences for life on Earth.

NASA's Earth observing and research program elements are the principal means by which global-scale questions about our home planet are posed and answered. These elements identify the variability in the Earth system, the forces responsible for change, the responses of the Earth system to changes, and the consequences and predictability of future change. Nations and industries make billions of dollars worth of investment decisions yearly that will be better informed by the information and understanding we provide.

Objective (IA): Discern and describe how the Earth is changing.

Annual Performance Goal 2Y1: Increase understanding of global precipitation, evaporation and how the cycling of water through the Earth system is changing by meeting at least 3 of 4 performance indicators.

It is important to establish a baseline for determining the existence or absence of significant trends in the water cycle, and the extent to which observed changes match predictions. Acceleration of the global water cycle could result in intensification and/or redistribution of rainfall patterns, severe storm frequency, droughts and glacial melting. Understanding of the water cycle enables prediction of freshwater availability.

- Combine analysis of global water vapor, precipitation and wind data sets to decipher variations (and possible trends) in the cycling of water through the atmosphere and their relation to Sea Surface Temperature changes.

- Analyze data from polar and geostationary satellites in a consistent fashion over at least two decades to evaluate whether the detectable moisture fluxes are increasing beyond the expected ranges of natural variability.

- Determine the time and spatial variability of the occurrence of strong convection regions, precipitation events, and areas of drought to assess whether or not there are discernable global changes in the distribution of moisture availability useful to food and fiber production and management of fresh water resources.

- Establish passive and active rainfall retrievals of zonal means to establish a calibration point for long-term data records of the World Climate Research Program, Global Precipitation Climatology Project (GPCP).

Annual Performance Goal 2Y2: Increase understanding of global ocean circulation and how it varies on interannual, decadal, and longer time scales by meeting 2 of 2 performance indicators.

Establishing the basis for variations in the temperature and circulation of the upper ocean can be used to help assess any changes that may be affecting the Earth's weather and climate, including El Niño phenomena.

- Routine (every ten days) analysis from a data-assimilating global ocean model, using NASA satellite observations, will be used to evaluate ocean circulation changes. [http://www.ecco.ucsd.edu/]

- Sponsor research and satellite data analysis to develop and publish the trends in the duration and dynamics of the sea ice season for the Arctic and Antarctic polar sea ice covers for the period 1979-1999.

Annual Performance Goal 2Y3: Increase understanding of global ecosystems change by meeting at least 3 of 4 performance indicators.

The activity establishes the basis for short-term, seasonal and inter-annual variability of ecosystems and provides a baseline against which to evaluate future change. Measurements of seasonal, annual and inter-annual changes in ecosystems are used to estimate productivity in agriculture, forestry, fisheries and Earth's unmanaged lands and oceans.

- Merge Moderate-Resolution Imaging Spectroradiometer (MODIS) instrument and Sea-viewing Wide Field-of-view Sensor (SeaWiFS) data to increase the global ocean color data coverage by 25% from a baseline of 17% per day.

- Test our ability to discriminate phytoplankton from other constituents in coastal waters using observations of phytoplankton fluorescence observations acquired by MODIS.

- Release first comprehensive validation of MODIS land data products using results from the South African Fire-Atmospheric Research Initiative (SAFARI 2000) field campaign and related field validation programs.

- Establish a quantitative relationship between vegetation indices time series derived from Advanced Very High-Resolution Radiometer (AVHRR) and MODIS to ensure long-term continuity and comparability of time series.

Annual Performance Goal 2Y4: Increase understanding of stratospheric ozone changes, as the abundance of ozone-destroying chemicals decreases and new substitutes increases by meeting 2 of 2 performance indicators.

Reduction in atmospheric ozone amounts leads to an increased flux of ultraviolet radiation at the Earth's surface, with harmful effects on plant and animal life including human health.

- Provide continuity of calibrated data sets for determining long term trends in the total column and profile abundances of stratospheric ozone with sufficient precision to enable the later assessment of expected ozone recovery.

- Characterize the inter-annual variability and possible long-term evolution of stratospheric aerosol characteristics and profile abundances to assist in the interpretation of observed ozone changes and Chemistry-climate interactions. This requires a combination of consistently processed data records from ground-based, airborne, balloon-borne, and space-based measurements.

Annual Performance Goal 2Y5: Increase understanding of change occurring in the mass of the Earth's ice cover by meeting at least 3 of 4 performance indicators.

Sea level is estimated to have been rising by about 2 mm/year over the last century. Possible contributions to this change include thermal expansion of the oceans and the loss of ice from glaciers and the large ice sheets. Of these, the large ice sheets present the greatest uncertainty in terms of their contribution to sea level rise and also represent the greatest potential threat to

the coastal ecosystems and infrastructure. It is therefore important to establish whether polar regions are in the process of losing mass and contributing to the current observed sea level rise.

- Submit for publication the first Greenland ice sheet accumulation rate and its inter-annual variability maps for the period 1975-98.

- Provide the first record of changes and variability in extent of Greenland ice sheet surface melt over the 21 years, 1979-1999, and submit for publication.

- Produce the first map of Antarctic ice sheet margin change, 1997-2000, covering key regions of the Antarctic coastline and submit this for publication.

- Define parameters for separating post-glacial rebound from ice mass changes based on Gravity Recovery And Climate Experiment (GRACE) and Ice, Clouds, and Land Elevation Satellite (ICESat) observations.

Annual Performance Goal 2Y6: Increase understanding of the motions of the Earth, the Earth's interior, and what information can be inferred about the Earth's internal processes by meeting at least 3 of 4 performance indicators.

Motions of the Earth's Interior are the forcings which drive earthquakes, volcanoes and build our mountains and valleys. Knowledge, which has been building over the past decades, has led to a quantum leap in our understanding of how our planet has evolved. Through this new knowledge has come a better understanding of natural hazards and natural resource assessment. Technological by-products include better navigation (including civilian Global Positioning System (GPS)), the tracking of ocean height variability and the attendant visualization of EL Nino and related phenomena to name just a few of many applications.

- Produce first estimate of the secular (Long-Term) change of the Earth's magnetic field from continuous satellite measurements of the geomagnetic field. Estimate the long-term variation to 3 nano Tesla/yr or better which is equivalent to a change of 1 part in 20,000.

- Complete the evaluation of the Continuous Observations of the Rotation of the Earth (CORE) concept to demonstrate a nearly 300% improvement in Earth rotation precision using the new Mark IV correlator technology and an international consortium of Very Long Baseline Interferometry (VLBI) observatories.

- Complete Solar Laser Ranging 2000 (SLR2000) prototype development and begin evaluation of the performance of new SLR2000 automated satellite ranging station.

- Evaluate the ability of the real-time precision GPS positioning software to produce better than 40 cm global real-time positioning using NASA's Global GPS Network.

- Complete preliminary algorithms for mass flux estimation from temporal gravity field observations in preparation for the GRACE mission.

Objective (IB): Identify and measure the primary causes of change in the Earth system.

Annual Performance Goal 2Y7: Increase understanding of trends in atmospheric constituents and solar radiation and the role they play in driving global climate by meeting at least 3 of 4 performance indicators.

Solar radiation is the primary external force acting on Earth's climate. Atmospheric constituents, clouds and aerosols drive the climate system; changes in their concentration/distribution will contribute to climate change through a variety of processes.

- Provide continuity of 22 years of concentration measurements (and associated standards development) of anthropogenic and naturally occurring halogen-containing chemicals and other chemically active greenhouse gases to provide for an understanding of future changes in ozone and climate forcing.

- Use data assimilation techniques to combine Carbon Monoxide and Methane measurements from Measurements of Pollution in the Troposphere (MOPITT) with chemical transport models of the atmosphere to help characterize interannual differences in global emissions.

- Provide first comprehensive multi-instrument/multi-angle integrated data set for study of sources/sinks and distribution of tropospheric aerosols over land based on data from Total Ozone Mapping Spectrometer (TOMS), MODIS, and Multi-angle Imaging Spectroradiometer (MISR) instruments.

- Reduce the uncertainty in the retrievals of upper troposphere / lower stratosphere water vapor (from microwave soundings) by 10 – 30% through improved laboratory spectroscopic measurements of the water vapor continuum.

Annual Performance Goal 2Y8: Increase understanding about the changes in global land cover and land use and their causes by meeting at least 2 of 3 performance indicators.

Change in land cover and land use is the dominant present-day forcing of change in terrestrial and coastal ecosystems and constitutes our largest uncertainty in the global carbon budget. Understanding the human and biophysical factors that cause land cover and land use change will be essential for assessing consequences for food production, natural resources availability, and resource management as well as for predicting future global changes.

- Publish the first set of regional land cover and land use change case studies and a synthesis of their results.

- Characterize the role of land cover changes associated with natural fires in determining the carbon balance of ecosystems in at least two major regions of the boreal forests, quantify their impact on the global carbon budget, and submit the results for publication.

- Characterize the role of deforestation in the carbon balance of ecosystems of the Amazonian tropical forest, quantify the impact on the global carbon budget, and submit the results for publication.

Annual Performance Goal 2Y9: Increase understanding of the Earth's surface and how it is transformed and how such information can be used to predict future changes by meeting at least 4 of 5 performance indicators.

This effort is leading to a better understanding of natural events/processes that transform or change the topographic surface of the Earth, and the impact of such changes on human activities. Progress toward answering this question will lead to a better understanding of the risk of natural hazards and societies vulnerability to natural disasters. By products of these activities include better topographic maps of the Earth surface. These are important to many endeavors such as airplane landing and routing, watershed assessment, and roadway planning. Risk assessment for natural hazards such as flooding, earthquakes, landslides and volcanoes is becoming increasingly important as societal resources are developed and concentrated in vulnerable areas.

- Begin 5-yr assessment of utility of completed Southern California Integrated GPS Network in understanding tectonic activities.

- Perform a new integrated earthquake risk assessment of the Los Angeles basin based on continued measurement of accumulated strain in the southern California region.

- Continue providing the Digital Elevation Models (DEM) of the Earth for scientific studies and practical applications.

- Evaluate the utility of single frequency GPS array technology for assessing volcanic deformation processes.

- Characterize and model topographic evolution processes in at least two major tectonically active regions of the world and publish results.

Objective (IC): Determine how the Earth system responds to natural and human-induced changes.

Annual Performance Goal 2Y10: Increase understanding of the effects of clouds and surface hydrologic processes on climate change by meeting at least 4 of 5 performance indicators.

It is important to establish a basis for determining the vertical distribution and optical properties of cloud particles to provide measurement-based estimates of atmospheric heating rather than relying on climatological statistics or models. Clouds are the most important factor that controls the Earth's radiation balance, which, along with evaporation and condensation of atmospheric and surface water, drives the major weather systems. Thus, determining the vertical distribution and optical properties of cloud particles will ultimately lead to better climate predictions. Soil moisture is an important land surface state variable, currently unmeasured at large spatial scales, that also affects weather and climate.

- Continue assembling and processing of satellite data needed for the multi-decadal global cloud Climatology being developed under the International Satellite Cloud Climatology Project (ISCCP). Reduce uncertainty (3-7% in monthly mean) in the current ISCCP dataset of globally observed cloud characteristics, particularly in the polar regions, by comparing it with new satellite datasets that provide new constraints on the derived quantities and with in situ ground-based and airborne measurements.

- Initiate development of the Cirrus Regional Study of Tropical Anvils and Layers (CRYSTAL) field study to determine the upper tropospheric distribution of ice particles and water vapor and associated radiation fluxes on storms and cloud systems, and on cloud generation, regeneration and dissipation mechanisms and their representation in both regional-scale and global climate models.

- Improve the determinations of radiation forcings and feedbacks, and thereby increase accuracy in our knowledge of heating and cooling of the Earth's surface and atmosphere. Continue the analysis of global measurements of the radiative properties of clouds and aerosol particles being made by MISR and Clouds and the Earth's Radiant Energy System (CERES) instruments on the Terra and Aqua spacecraft.

- Demonstrate over a variety of landscapes the capability to measure and diagnose soil moisture from airborne platforms, in preparation for a space-flight trial of soil moisture remote sensing.

- Improve the understanding and modeling of the aerosol radiative forcing of climate and its anthropogenic component (reduce current uncertainties of 0.1 to 0.05 in the aerosol column optical thickness and 1 to 0.4 in the Angstrom coefficient). Develop and validate aerosol retrieval and cloud screening algorithms, and processing of satellite data and transport model evaluations for a 20-year Climatology of aerosol optical thickness and particle size.

Annual Performance Goal 2Y11: Increase understanding of how ecosystems respond to and affect global environmental change and affect the global carbon cycle by meeting at least 4 of 5 performance indicators.

Today, Earth's ecosystems are experiencing multiple, interacting, changing environmental conditions, and it will be vitally important to understand the implications of their responses, including some that may surprise us, for sustained agriculture, forestry, and fisheries, and for the continued provision of ecosystem goods and services that are valuable to human societies. We also need to know how their responses provide feedback to the atmosphere through fluxes of water, energy, and trace gases. Most importantly, we must develop understanding of the past, present, and future role of ecosystems as sources and sinks of carbon and in regulating the global carbon cycle.

- Demonstrate the feasibility of using remote sensing imagery to identify functional groups of phytoplankton in the ocean.

- Develop a relationship between oceanic primary productivity and export of carbon to the deep-sea based on remote sensing observations and ocean biology models.

- Conduct airborne remote sensing campaign in Amazonia to evaluate measurement approaches for vegetation recovery and biomass change following forest clearing and impact of this secondary growth on removal of water from the atmosphere.

- Assemble and publish the first comprehensive regional analysis of the linkages between land-atmosphere interaction processes and the relationship between trace gas and aerosol emissions and the consequences of their deposition to the functioning of the ecosystems of southern Africa.

- Conduct diagnostic analysis of results from new carbon cycling models that improve the treatment of land use and land management and incorporate the effects of nutrient deposition as well as climate change, carbon dioxide enrichment, and land cover change to assess interrelation among these multiple factors affecting these ecosystems.

Annual Performance Goal 2Y12: Increase understanding of how climate variations induce changes in the global ocean circulation by meeting at least 4 of 6 performance indicators.

Ocean circulation patterns strongly influence regional climates, yet these are known to have exhibited variability. For example, circulation associated with the north Atlantic "conveyor" belt, including the Gulf Stream, provides for the relatively mild climate of northern Europe. Changes in such large-scale ocean circulation could significantly impact the habitability of this region.

- Diagnostic analysis of seasonal and interannual variability induced in the interior ocean based on forcing of an ocean model with three years of high resolution ocean winds (Ocean Surface Vector Winds Science Team).

- Near decade-long sea surface topography time series will be assimilated into high resolution Pacific Ocean model to elucidate the mechanisms of the Pacific Decadal Oscillation and its impact on seasonal/decadal climate variations.

- From Ocean Topography Experiment (TOPEX) time series, in situ observations of the World Ocean Data Assimilation Experiment, and assimilation of these data into ocean models, ascertain whether detectable changes in the deep ocean have occurred over the last decade.

- Submit for publication the first estimate of the inter-annual variability of Arctic Ocean seasonal ice production and heat and brine flux, from three years of Canadian Radar Satellite (RADARSAT) observations.

- Complete a preliminary review of how data assimilation techniques are currently being used to improve knowledge of the polar oceans (in particular the Arctic), through convening a workshop. Provide recommendations that outline the way forward for future application of data assimilation techniques for polar oceans research in NASA's ESE.

- Submit for publication twenty years of “Fram Strait” sea ice flux from RADARSAT and passive microwave ice motion. Sea ice flux through the Fram Strait represents export of fresh water from the Arctic Ocean, which in turn influences deep ocean circulation and climate variations.

Annual Performance Goal 2Y13: Increase understanding of stratospheric trace constituents and how they respond to change in climate and atmospheric composition by meeting 2 of 2 performance indicators.

Stratospheric composition, most importantly amounts of ultraviolet (UV)-absorbing ozone, respond to concentrations of chemically active trace gases and underlying meteorological conditions, such as temperature and wind distributions. Changing atmospheric conditions associated with global chemical change (and associated global warming) have the potential to affect the stratosphere, which can in turn affect fluxes of biologically-damaging UV radiation at the Earth's surface.

- Assess the possible impact of the increased abundances of greenhouse gases on the future evolution of Northern Hemisphere high latitude ozone concentration. Based on data from the Sage Ozone Loss and Validation Experiment (SOLVE) experiment.

- Document and submit for publication the respective variability of temperatures, ozone concentrations, and water vapor in and above the tropopause region and assess the interconnectedness of these changes through retrospective modeling and data analysis.

Annual Performance Goal 2Y14: Increase understanding of global sea level and how it is affected by climate change by meeting at least 2 of 3 performance indicators.

The polar ice sheets are a repository for about 75% of the Earth's fresh water and a reduction in their combined mass of just 1% would increase sea level by about 90 cm. Of the order of 100 million people would be at direct risk from a sea level rise of this magnitude (Intergovernmental Panel on Climate Change (IPCC), 1995) and many more would be indirectly affected through economic and other impacts. It is therefore important to establish whether the ice sheets have the potential, under climate change scenarios, to exhibit major changes in mass balance and if so, what the expected time-scale for such changes would be.

- Map the surface velocities at their outlets of at least 10 major outlet glaciers draining West Antarctica and at least 10 outlet glaciers draining East Antarctica and determine the positions where these glaciers start to float with a precision of 100 m. Submit these maps for publication.

- Compare new estimates of ice discharge of 20 or more Antarctic glaciers with interior mass accumulation to provide the first estimates of mass balance for their grounded ice catchments. Submit these estimates for publication.

- Establish a methodology for refining ice stream models based on radar sounding, surface velocity and surface topographic observations. Generate a technical report for peer review.

Annual Performance Goal 2Y15: Increase understanding of the effects of regional pollution on the global atmosphere, and the effects of global chemical and climate changes on regional air quality by meeting at least 4 of 5 performance indicators.

There is significant evidence that pollutant gases can be transported over very long distances (e.g., across the Pacific or Atlantic oceans). The global effects of atmospheric pollution (on agriculture, materials, human health, etc.) are poorly known due to inexact characterization of tropospheric transport, physics, and chemistry**.**

- Continue and extend the three year data record in order to build climatology of the high resolution vertical distribution of ozone in the tropics to improve the retrievals of tropospheric ozone concentrations based on the residual products from space-based observations.

- Archive and analyze data from the Transport of Chemical Evolution over the Pacific (TRACE-P) airborne mission and associated data sets to characterize the atmospheric plume from East Asia and to assess its contribution to regional and global atmospheric chemical composition.

- Estimate the tropospheric distributions of Hydroxyl (OH) and examine the consistency between inverse and assimilation models in determining global OH fields using multiple data sets; document via submission of one or more publications to peer-reviewed literature.

- Simulate changes in atmospheric composition projected over the 21st century with a coupled aerosol-chemistry-climate general circulation model including projected changes in anthropogenic emissions. This model, which will include first-time parameterization of tropospheric aerosol chemistry, will help to diagnose the climatic consequences of these emissions and the associated feedbacks on atmospheric composition.

- Estimates of the stratospheric contribution to tropospheric ozone will be made through chemical transport and Lagrangian transport models. The stratosphere-troposphere exchange included in these model calculations will be examined for its sensitivity to global warming.

Objective (ID): Identify the consequences of change in the Earth system for human civilization.

Annual Performance Goal 2Y16: Increase understanding of variations in local weather, precipitation and water resources and how they relate to global climate variation by meeting 2 of 2 performance indicators.

This activity establishes a basis for determining what changes will be induced by climate trends in the frequency, strength, and path of weather systems, which produce clouds and rain and replenish fresh water supplies.

- Characterize the interannual variations of deep tropical convection utilizing existing and new satellite-based datasets to understand relations between large-scale surface and atmospheric forcing and tropical forcing and submit results for publication.

- Demonstrate impact of assimilation of Tropical Rainfall Measuring Mission (TRMM) rainfall data on forecasting track and intensity of tropical storms by showing improvement in near real-time hurricane and typhoon forecasts in a variety of cases/conditions.

Annual Performance Goal 2Y17: Increase understanding of the consequence of land cover and land use change for the sustainability of ecosystems and economic productivity by meeting at least 2 of 3 performance indicators.

Today, land cover and land use changes are primarily due to human activities, and are most prevalent where human populations are large; thus the consequences of land cover and land use change impact our daily lives and the potential sustainability of food production, natural resource use, and environmental quality. Consequences of concern include changes in carbon sources and sinks; the loss of biodiversity; inputs of sediments, nutrients, and pollutants to coastal regions; land degradation, and increased risks to human health.

- Release a document describing the first set of regional land cover and land use change case studies and providing a synthesis of their results.

- Develop models incorporating the biophysical, socio-economic, institutional, and demographic determinants of land use and land cover change in Amazonia.

- Enable the scientific interchange of data, methods, and results through the operation of regional networks of scientists in four major regions of the world.

Annual Performance Goal 2Y18: Increase understanding of the consequences of climate and sea level changes and increased human activities on coastal regions by meeting 2 of 2 performance indicators.

The consequences of global environmental change are often seen in the coastal zone. Human populations are concentrated near coastlines, and there are severe impacts on coastal communities from pollution, excess nutrients, storm-surge and sea-level rise. It will be important to understand the relative contributions of each of these factors to the overall changes in coastal regions, and especially, their effect on the resident human communities.

- Increase the coverage of space-based maps of coral reef distribution by 25% beyond current estimates using remotely sensed imagery.

- Develop an improved algorithm for retrievals of ocean color information from remotely sensed observations of turbid coastal systems (i.e. Case 2 water).

Objective (IE): Enable the prediction of future changes in the Earth system.

Annual Performance Goal 2Y19: Increase understanding of the extent that weather forecast duration and reliability can be improved by new space-based observations, data assimilation and modeling by meeting at least 2 of 3 performance indicators.

This activity contributes to improving the accuracy of short-term weather predictions and increasing the period of validity of long-range forecasts which are used by government, business, and individuals to protect lives and property and make investment decisions.

- Determine tropical mean convection structure (fraction of convective vs. stratiform rainfall) for the first time using TRMM's first three years of data and submit results for publication.

- Define the quantitative requirements for new operational sensors, including space-based tropospheric winds through participation in inter-agency Observing System Simulation Experiments (OSSE).

- Develop new analysis methods that integrate global observations from the complete suite of satellite (and conventional) weather measurements into a single, self-consistent analysis of water-related phenomena (diabatic heating by radiation and precipitation, water vapor and clouds, inference of water and energy fluxes and transports). This development provides for developing requirements for new satellite sensors and new data assimilation techniques.

Annual Performance Goal 2Y20: Increase understanding of the extent that transient climate variations can be understood and predicted by meeting at least 4 of 5 performance indicators.

This activity contributes to the ability to predict global and regional climate on seasonal-to-interannual time scales with sufficient accuracy for concerned socioeconomic interests to estimate the likely impact of climate variations, such as those associated with El Nino/La Nina, and to issue warnings and make appropriate contingency plans. NASA will endeavor to transition the results of this research to those public agencies that have operational planning and warning responsibilities and will also make the results available to concerned interests in the private sector.

- Document in the peer-reviewed literature the quantified impact of satellite altimeter observations on improving 12-month El Nino forecasts with a state-of-the-art coupled ocean-atmosphere-land model by comparing model predictions initialized with in-situ data and both with and without satellite altimeter data.

- Contribute to national seasonal forecasts by delivering ensembles of forecast products (e.g., surface temperature, precipitation, upper level winds) to Operational agencies (e.g., National Center for Environmental Prediction (NCEP), International Research Institute (IRI)). Forecasts with and without the use of satellite-based data will be used to document the impact of such remotely sensed data on forecast quality.

- Estimate and document potential predictability, based on multi-year reanalysis data and modeling, of regional climate variability in order to evaluate the relative contributions of seasonal-to-interannual and decadal climate variability on specific regions, with a focus on occurrence of major floods and droughts in North America and the Asian-Australian monsoon regions.

- Develop, implement, and document advanced cloud radiation and moist physics schemes in NASA climate models, and validate them against remotely-sensed radiation data, in order to improve overall skill of climate model simulations of the global energy and water cycles.

- Use multi-year satellite observations of lightning to assess the relationship of strong convection to interannual climate variations (e.g., El Nino and La Nina), and use as proxy data to assist in evaluating model representation of convective precipitation. Document results.

Annual Performance Goal 2Y21: Increase understanding of the extent that long-term climate trends can be assessed or predicted by meeting at least 4 of 5 performance indicators.

This activity will provide information needed to determine policies for possible mitigation of, or adaptation to, climate change. Specifically, it will provide information on the causes of recent and current climate changes and the expected magnitude and causes of future climate trends including the nature of regional climate changes. An integral part of this research is an assessment of the reliability of climate predictions and how alternative assumptions and policies affect them.

- Monitor global tropospheric and stratospheric temperatures, to validate climate model simulations, and to improve understanding of the relationship between surface and upper-air temperatures in a changing climate system. Document results.

- Quantify and document the likely contributions of different climate forcings (greenhouse gases, ozone, water vapor, solar irradiance) to observed long-term trends of the Arctic Oscillation. The Arctic Oscillation has practical significance as it affects the geographical patterns of climate variability and change in the troposphere.

- Quantify and document the degree to which the stratosphere and mesosphere need to be incorporated and resolved in climate models to realistically simulate interannual and decadal climate variability and change in the troposphere.

- Quantify and document the role of different forcings (greenhouse gases, ozone, water vapor, solar irradiance, stratospheric and tropospheric aerosols) and unforced (chaotic) variability in determining the evolution of global climate over the past 50 years, to develop confidence in quantitative model predictions of future climate change.

- Make quantitative comparisons of the ability of alternative ocean modeling treatments to simulate climate variability and change on interannual to century time scales. Document results.

Annual Performance Goal 2Y22: Increase understanding of the extent that future atmospheric chemical impacts on ozone and climate can be predicted by meeting at least 2 of 3 performance indicators.

A sound scientific basis is essential for informed decision making at the national and international level on environmental issues that underlie human health and well being and the health of the numerous ecosystems. Only through the integration of science and policy, as occurred effectively through the assessment process (for example the various assessment panels associated with the Montreal Protocol), can the sustainable development of our Nation be insured.

- Analyze the measured trends in atmospheric trace gas concentrations and compare with those estimated from industrial production and emission data. Analysis will be used to assess the completeness of our understanding of the atmospheric persistence and degradation of industrial chemicals as well as to examine the efficiency of current regulatory agreements and international reporting on the production and emissions of regulated chemicals.

- Conduct laboratory studies designed to assess the atmospheric fate of new industrial chemicals by characterizing the key photochemical processes responsible for their atmospheric breakdown.

- Continue the implementation of the Global Modeling Initiative (GMI) to provide metrics, benchmarks and controlled numerical experiments for model and algorithm simulations performance, which will allow the development of standards of model behavior for participation in assessment exercises.

Strategic Goal (II): Expand and accelerate the realization of economic and societal benefits from Earth science, information & technology.

Scientific data must be transformed into information products useful to non-scientists in order for the economy and society to realize the full benefit of it. Our applications and education programs are designed to achieve this end through partnerships between NASA and professional information product providers and educators. The accomplishment of the identified performance indicators will enable the user community to accomplish their day-to-day decision-making in a more effective manner resulting in either cost savings, improved timeliness or quality, or to accomplish tasks that were not previously possible with conventional means. The accomplishment of the performance indicators will enable the U.S. taxpayer to reap the potential socio-economic benefits of NASA's investment in Earth science and technology.

Objective (IIA): Demonstrate scientific and technical capabilities to enable the development of practical tools for public and private-sector decision makers.

Annual Performance Goal 2Y23: Provide regional decision-makers with scientific and applications products and tools.

Increased application of and access to ESE's science and technology results will enable the Nation to reap significant benefits in the areas of community growth and infrastructure, disaster management, environmental assessment, and resource

management. The performance indicators are aimed at measuring: (a) the identification of the most significant needs in the federal, state, local and tribal government community that can benefit from these results; (b) the development of new and advanced applications and related methods and practices in cooperation with the user community; and (c) the distribution of these results to the broader user population. The accomplishment of the identified target indicators and related application activities will enable the user community to accomplish their day-to-day decision-making in a more effective and efficient manner resulting in either cost savings, improved timeliness or quality, or in an ability to accomplish tasks that were not previously possible with conventional means. The accomplishment of the performance indicators will enable the U.S. taxpayer to reap the potential socio-economic benefits of NASA's investment in Earth science and technology.

- Conduct Program Planning and Analysis activities that result in the identification of five potential demonstration projects where user needs match NASA ESE science and technology capabilities.

- Develop two new joint demonstration projects with the user community.

Objective (IIB): Stimulate public interest in and understanding of Earth system science and encourage young scholars to consider careers in science and technology.

Annual Performance Goal 2Y24: Share NASA's discoveries in Earth science with the public to enhance understanding of science and technology.

Increased public awareness and understanding of how the Earth functions as a system and increased literacy in Earth science and technology will result in quality teaching and learning about the Earth and its environment, and build capacity for productive use of Earth science information in resolving everyday practical problems. Success will equate to meeting 3 of 4 performance indicators.

- Release at least 50 "stories" per year that cover scientific discoveries, practical benefits or new technologies.

- Sponsor assistance to at least 2 leading undergraduate institutions to develop courses that enable pre-service science educators to become proficient in Earth system science.

- Continue to train a pool of highly qualified scientists and educators in Earth science and remote sensing by sponsoring approximately 140 fellowships (50 of which are new) and a total of 30 New Investigator Program awards.

- Work with at least one professional society to develop content standards for professional practice of Earth remote sensing.

Strategic Goal (III): Develop and adopt advanced technologies to enable mission success and serve national priorities.

New and less costly remote sensing capabilities are made possible by targeted investment in advanced technologies. These technologies will make possible the next generation of weather, climate and Earth systems monitoring satellites. They will leverage advances in information technologies to make vast quantities of Earth science data useful and accessible to scientists, practitioners, and the public.

Objective (IIIA): Develop advanced technologies to reduce the cost and expand the capability for scientific Earth observation.

Annual Performance Goal 2Y25: Successfully develop and infuse technologies that will enable future science measurements, and/or improve performance and reduce the cost of existing measurements. Increase the readiness of technologies under development, advancing them to a maturity level where they can be infused into new missions with shorter development cycles.

New technology enables measurements that have never been previously made. Often, these measurements enable the early warnings to the public of natural hazards (ozone, chemical or particulate threats) or life threatening weather conditions and allow study of Earth from new vantagepoint of space. Alternatively, many new technologies reduce the cost of existing measurements while improving their quality. Predictive information can be generated for the public with more reliability, at lower cost and in delivery of resulting information in a shorter period.

- Annually advance 25% of funded technology developments one Technology Readiness Level (TRL)
- Mature 2-3 technologies to the point where they can be demonstrated in space or in an operational environment.
- Enable one new science measurement capability or significantly improve performance of an existing one.

Objective (IIIB): Develop advanced information technologies for processing, archiving, accessing, visualizing, and communicating Earth science data.

High-end computational modeling capabilities will enable in-depth analysis and simulation of earth system processes. This analysis will lead to higher quality, more refined characterization of the Earth system and longer-range predictions of natural hazards or life threatening weather conditions.

Annual Performance Goal 2Y26: Develop hardware/software tools to demonstrate high-end computational modeling to further our understanding and ability to predict the dynamic interaction of physical, chemical and biological processes affecting the earth.

- Successfully establish networked high performance computer testbed for Earth science modeling challenges.

- Finalize Earth science multidisciplinary, integrated Modeling Framework requirements by holding successful system design review.

Annual Performance Goal 2Y27: Develop baseline suite of multidisciplinary models and computational tools leading to scalable global climate simulations.

- Attain a three time improvement over negotiated baseline for three to eight Earth Science modeling codes transferred to the high performance computer testbed.

- Successfully demonstrate up to three Earth science modeling codes interoperating on a functioning Modeling Framework prototype.

Objective (IIIC): Partner with other agencies to develop and implement better methods for using remotely sensed observations in Earth system monitoring and prediction.

Lowering overall costs to the government, collaboration permits NASA to utilize other agencies' skills and resources, precluding inefficient duplication of missions and research efforts.

Annual Performance Goal 2Y28: Collaborate with other Federal and international agencies in developing and implementing better methods for using remotely sensed observations.

- Continue to take advantage of collaborative relations with U.S. Geological Survey (USGS), U.S. Department of Agriculture (USDA) and Environmental Protection Agency (EPA) to promote the use of remotely sensed data and information to accomplish U.S. strategic scientific, environmental and economic objectives.

- Demonstrate enhanced interoperability and interconnectivity of international remote sensing information systems and services through NASA's participation in the Committee on Earth Observation Satellites (CEOS) Working Group on Information Systems and Services.

- Demonstrate enhanced mission coordination and complementarity of remote sensing data through NASA's participation in the CEOS Working Group on Calibration and Validation.

- Demonstrate the establishment of an agreed international approach to an integrated global observing strategy for the oceans and the terrestrial carbon cycle through participation in the Integrated Global Observing Strategy - Partners (IGOS-P).

Enterprise-Wide Activities that enable achievement of Earth Science strategic goals.

Annual Performance Goal 2Y29: Successfully develop, have ready for launch, and operate instruments on at least two spacecraft to enable Earth Science research and applications goals and objectives.

- Successfully develop and have ready for launch at least two spacecraft.
- At least 90% of the total on-orbit instrument complement will be operational during their design lifetime.

Annual Performance Goal 2Y30: Successfully disseminate Earth Science data to enable our science research and applications goals and objectives. Success will equate to meeting 4 of 5 performance indicators.

- Make available data on seasonal or climate prediction, and land surface changes to users within 5 days of their acquisition.
- Increase by 50% the volume of data acquired and archived by NASA for its research programs compared to FY01.
- Increase the number of distinct NASA Earth Observing System Data and Information System (EOSDIS) customers by 20% compared to FY01.
- Increase scientific and applications data products delivered from the Earth Observing System (EOS) Distributed Active Archive Centers (DAACs) by 10% compared to FY01.
- User satisfaction: increase the number of favorable comments from DAAC and Earth Science Information Partner (ESIP) users as recorded in the customer contact logs over FY01; decrease total percentage of order errors by 5% over FY01.

Annual Performance Goal 2Y31: Safely operate airborne platforms to gather remote and *in situ* earth science data for process and calibration/validation studies.

- Support and execute seasonally dependent coordinated research field campaigns within one-week of target departure with the aid of airborne and sub-orbital platforms, as scheduled at the beginning of the fiscal year.

Verification and Validation

While performance indicators are noted in order to demonstrate significant scientific progress toward the annual performance goal, the ESE will also rely on external expert review. The Earth Science Advisory Committee of the NASA Advisory Council will conduct an annual assessment of the ESE's near-term science objectives. It will provide a qualitative progress measurement (Green, Yellow,

or Red). "Green" will indicate that the objective was met; "Yellow" will indicate a concern that an objective was not fully accomplished; and "Red" will indicate that events occurred that prevented or severely impaired the accomplishment of the objective. The assessment will include commentary to clarify and supplement the qualitative measures.

Earth System Science and Applications Advisory Committee (ESSAAC) is a committee of the NASA Advisory Council under the Federal Advisory Committee Act, and comprises outside scientific and technical experts from academia, industry and other government agencies. ESSAAC meets at least twice a year to review plans and progress in the ESE. After the end of each fiscal year, the ESE will provide to ESSAAC a self-assessment in each of the relevant objectives, highlighting performance against the metrics in the Performance Plan for that year. ESSAAC will deliberate internally and render its own assessment, which may confirm or modify ESE's self-assessment. ESSAAC's assessment will be reported in the Performance Report for that year. This process will be repeated annually.

The ESE will regularly review performance objectives as part of an existing monthly review process. Tracking current performance on a monthly basis for each specific FY02 annual performance goal enables the ESE to institute measures to ensure improvement and progress toward meeting its strategic goals.

Multi-year Performance Trend
Earth Science Enterprise

***New objectives have been developed for FY 2002. The targets can be mapped to the following new objectives:**

Objective (1A): Discern and describe how the Earth is changing.
Objective (1B): Identify and measure the primary causes of change in the Earth system.
Objective (1C): Determine how the Earth system responds to natural and human-induced changes
Objective (1D): Identify the consequences of change in the Earth system for human civilization.
Objective (IE): Enable the prediction of future changes in the Earth system.

FY 99-01 Strategic Objective: Understand the causes and consequences of land-cover/land-use change

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	Collect near-daily measurements of ocean color (index of ocean productivity from which calculations of ocean update of carbon are made). (Y3). Refresh the global archive of 30m land imagery from Landsat 7, two to three times per year. A single global archive has not been constructed since late 1970's. This will include a 15m panchromatic band (Y1).	SIMBIOS will merge MODIS ocean color data into the global ocean color time series, which began with Ocean Color Temperature Sensor (OCTS) and SeaWiFS. Use time series to understand and predict response of the marine ecosystem to climate change. Make data set available via the Goddard DAAC (0Y4). Continue the ocean color time series with 60% global coverage every 4 days (0Y3). Continue the development of a global land-cover/use change data set based on Landsat and EOS instrument, at seasonal refresh rate (0Y1).	Increase understanding of the dynamics of the global carbon cycle by developing, analyzing and documenting multi-year data sets and meeting at least 3 of 4 performance indicators in this research area (1Y3). Explain the dynamics of global carbon cycle by building improved models and prediction capabilities and meeting 2 of 2 performance indicators in this research area (1Y4).	Increase understanding of global ecosystems change by meeting at least 3 of 4 performance indicators (2Y3). Increase understanding about the changes in global land cover and land use and their causes by meeting at least 2 of 3 performance indicators (2Y8). Increase understanding of how ecosystems respond to and affect global environmental change and affect the global carbon cycle by meeting at least 4 of 5 performance indicators (2Y11).
Assessment	Y3 and Y1 were yellow	0Y4 was yellow. 0Y3 and 0Y1 were green.	TBD	TBD

FY 99-01 Strategic Objective: Understand the causes and consequences of land-cover/land-use change (continued)

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	Collect near-daily global measurements of the terrestrial biosphere (index of terrestrial photosynthetic processes from which calculations of carbon uptake are made) from instruments on TERRA (Y2).	Continue to collect near-daily global measurements of the terrestrial biosphere (index of terrestrial photosynthetic processes from which calculations of carbon uptake are made) from instruments on TERRA (0Y2). Produce near-real-time fire monitoring and impact assessment based on Landsat and EOS inventory and process monitoring to provide an observational foundation for monitoring change in ecosystem productivity and disturbance. Post near-real-time assessments on a web site for quick access by researchers and regional authorities (0Y7).		Increase understanding of the consequence of land cover and land use change for the sustainability of ecosystems and economic productivity by meeting at least 2 of 3 performance indicators (2Y17). Increase understanding of the consequences of climate and sea level changes and increased human activities on coastal regions by meeting 2 of 2 performance indicators (2Y18).
Assessment	Yellow	0Y2 was green. 0Y7 was green		TBD

***New objectives have been developed for FY 2002. The targets can be mapped to the following new objectives:**

Objective (1A): Discern and describe how the Earth is changing.
Objective (1B): Identify and measure the primary causes of change in the Earth system.
Objective (1C): Determine how the Earth system responds to natural and human-induced changes
Objective (1D): Identify the consequences of change in the Earth system for human civilization.
Objective (IE): Enable the prediction of future changes in the Earth system.

FY 99-01 Strategic Objective: Predict seasonal-to-interannual climate variations

	FY 1999	**FY 2000**	**FY 2001**	**FY 2002**
Annual Performance Goal and APG #	TRMM will begin the second of a 3-year sequence of instantaneous measurements of rainfall rates and monthly accumulations in the global tropics. This will be the first measurement of global tropical rainfall. Current uncertainty is 50 percent. TRMM data will reduce uncertainty to 10 percent. (Y4). QuikScat to provide 25km resolution wind speed & direction measurements over at least 90% of the ice-free oceans every two days. Resolution increases by a factor of two, and a 15% increase of coverage over previous measurement (Y5).	Establish a benchmark for global and regional rainfall measurements by combining TRMM measurements with measurements from other sources. Create maps of the diurnal cycle of precipitation for the first time. Combine the existing ten-year data set with TRMM measurements to validate climate models and demonstrate the impact of rainfall on short-term weather forecasting. Distribute through the Goddard DAAC for ease of access to science and operational users (0Y9).	Increase understanding of the dynamics of global water cycle by developing, analyzing, and documenting multi-year data sets and meeting 2 of 2 performance indicators in this research area. (1Y5). Explain the dynamics of global water cycle by building improved models and prediction capabilities and meeting at least 2 of 3 performance indicators in this research area (1Y6).	Increase understanding of global precipitation, evaporation and how the cycling of water is changing by meeting at least 3 of 4 performance indicators (2Y1). Increase understanding of global ocean circulation and how it varies on interannual, decadal, and longer time scales by meeting 2 of 2 performance indicators (2Y2). Increase understanding of how climate variations induce changes in the global ocean circulation by meeting at least 4 of 6 performance indicators (2Y12)
Assessment		Green	TBD	TBD

FY 99-01 Strategic Objective: Predict seasonal-to-interannual climate variations (continued)

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		Develop/improve methods to couple state-of-the-art land surface and sea ice models to a global coupled ocean-atmosphere model and use to predict regional climactic consequences of El Nino or La Nina occurrence in the tropical Pacific. Results of research will be published in the open literature and provided to NOAA's National Climate Prediction Center and the U.S. Navy's Fleet Numeric Prediction Center. Ultimate goal: develop a capability to significantly improve the prediction for seasonal-to-interannual climate variations and their regional climate consequences. The main focus is on North America (0Y10).		Increase understanding of variations in local weather, precipitation and water resources and how they relate to global climate variation by meeting 2 of 2 performance indicators (2Y16) Increase understanding of the extent that weather forecast duration and reliability can be improved by new space-based observations, data assimilation and modeling by meeting at least 2 of 3 performance indicators (2Y19). Increase understanding of the extent that transient climate variations can be understood and predicted by meeting at least 4 of 5 performance indicators (2Y20).
Assessment		Green		TBD

FY 99-01 Strategic Objective: Predict seasonal-to-interannual climate variations (continued)

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		Measure production and radiative properties of aerosols produced by biomass burning in Africa based on SAFARI 2000 (field experiment) and EOS instruments. Includes extensive international participation. This burning is estimated to contribute one-half of global atmospheric aerosols (0Y11). Launch the NASA-CNES Jason-1 mission. This follow-on to TOPEX/ Poseidon is to achieve a factor-of-four improvement in accuracy in measuring ocean basin-scale sea-level variability. This is 1 order of magnitude better than that specified for TOPEX/Poseidon. (0Y12). Generate the first basin-scale high-resolution estimate of the state of the Pacific Ocean as part of the international Global Ocean Data Assimilation Experiment (GODAE) (0Y47).		
Assessment		0Y11 was green. 0Y12 was yellow 0Y47 was green.		

***New objectives have been developed for FY 2002. The targets can be mapped to the following new objectives:**

Objective (1A): Discern and describe how the Earth is changing.
Objective (1B): Identify and measure the primary causes of change in the Earth system.
Objective (1C): Determine how the Earth system responds to natural and human-induced changes
Objective (1D): Identify the consequences of change in the Earth system for human civilization.
Objective (IE): Enable the prediction of future changes in the Earth system.

FY 99-01 Strategic Objective: Identify natural hazards, processes, and mitigation strategies

	FY 1999	**FY 2000**	**FY 2001**	**FY 2002**
Annual Performance Goal and APG #	The Enterprise will provide the technology and instruments to create the first digital topographic map of 8o percent of Earth's land surface, everything between 60°N and 56°S. SRTM will be ready to launch in September 1999. (Y6). Use GPS array in southern California to monitor crustal deformation on a daily basis with centimeter precision; initiate installation of the next 100 stations. Data will be archived at JPL and run in models, with results given to the California Seismic Safety Commission and FEMA. (Y7).	Use Southern California Global Positioning System (GPS) array data to understand the connection between seismic risk and crustal strain leading to Earthquakes (0Y37). Develop models to use time-varying gravity observations for the first time in space (0Y38). Demonstrate the utility of spaceborne data for floodplain mapping with the Federal Emergency Management Agency (0Y39). Develop an automatic volcano cloud/ash detection algorithm employing EOS data sets for use by the Federal Aviation Administration (0Y40).	Increase understanding of the dynamics of the Earth's interior and crust by developing, analyzing, and documenting multi-year data sets and meeting 2 of 2 performance indicators in this research area (1Y11). Explain the dynamics of the Earth's interior and crust by building improved models and prediction capabilities and meeting 2 of 2 performance indicators in this research area (1Y12).	Increase understanding of the motions of the Earth, the Earth's interior, and what information can be inferred about the Earth's internal processes by meeting at least 3 of 4 performance indicators (2Y6). Increase understanding of the Earth's surface and how it is transformed and how such information can be used to predict future changes by meeting at least 4 of 5 performance indicators (2Y9).
Assessment	Green	Green	TBD	TBD

FY 99-01 Strategic Objective: Identify natural hazards, processes, and mitigation strategies (continued)

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	Use GPS data to test improved algorithms for sounding the atmosphere with the occulted GPS signal. Data will be archived at JPL and results published in science literature. (Y8).			
Assessment	Green			

***New objectives have been developed for FY 2002. The targets can be mapped to the following new objectives:**

Objective (1A): Discern and describe how the Earth is changing.
Objective (1B): Identify and measure the primary causes of change in the Earth system.
Objective (1C): Determine how the Earth system responds to natural and human-induced changes
Objective (1D): Identify the consequences of change in the Earth system for human civilization.
Objective (IE): Enable the prediction of future changes in the Earth system.

FY 99-01 Strategic Objective: Detect long-term climate change, causes, and impacts

	FY 1999	**FY 2000**	**FY 2001**	**FY 2002**
Annual Performance Goal and APG #	MODIS, MISR, ASTER, CERES (TERRA instruments) will begin to conduct daily observations of cloud properties such as extent, height, optical thickness and particle size. Data will be distributed through the Goddard DAAC (Y9). TERRA will map aerosol formation, distribution and sinks over the land and oceans (Y10). The TERRA instrument will achieve a 40-percent reduction in the uncertainty in Earth's radiation balance (that is improved angular models leading to an estimated error reduction in regional-scale monthly average net radiation of about 50 percent. (Y11).	Complete the collection of satellite data needed for the 17-year cloud climatology being developed under the International Satellite Cloud Climatology Project. Data will be used to improve the understanding and modeling of role of clouds in climate. Data will be available in the Goddard DAAC (0Y13). Continue the development of the global aerosol climatology data set and analysis of this climatology in climate models. Data will be available in the Goddard DAAC (0Y14). Provide for the continuation of the long-term, precise measurement of the total solar irradiance with the launch of EOS ACRIM (0Y15).	Increase understanding of the dynamics of long term climate variability by developing, analyzing, and documenting multi-year data sets and meeting at least 2 of 3 performance indicators in this research area (1Y7). Explain the dynamics of long term climate variability by building improved models and prediction capabilities and meeting at least 3 of 4 performance indicators in this research (1Y8).	Increase understanding of change occurring in the mass of the Earth's ice cover by meeting at least 3 of 4 performance indicators (2Y5). Increase understanding of the effects of clouds and surface hydrologic processes on climate change by meeting at least 4 of 5 performance indicators (2Y10). Increase understanding of global sea level and how it is affected by climate change by meeting at least 2 of 3 performance indicators (2Y14). Increase understanding of the extent that long-term climate trends can be assessed or predicted by meeting at least 4 of 5 performance indicators (2Y21).
Assessment	Yellow	All were green	TBD	TBD

FY 99-01 Strategic Objective: Detect long-term climate change, causes, and impacts (continued)

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		Acquire, through a Radarsat repeat of Antarctic Mapping Mission conducted in Sept.-Oct. 1997, a second set of high-resolution radar data over all of Antarctica for comparison with baseline data set acquired in 1997, to identify changes on the ice sheet (0Y16). Publish the first detailed estimates of thickening/thinning rates for all major ice drainage basins of Greenland ice sheet derived from repeated airborne laser-altimetry surveys. Measures represent the baseline data set to compare with early GLAS data (July 2001 launch) (OY17). Initiate a program of airborne mapping of layers within the Greenland ice sheet to decipher the impact of past climate variation of polar regions (0Y18).		
Assessment		All were green		

FY 99-01 Strategic Objective: Detect long-term climate change, causes, and impacts (continued)

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		Develop a remote-sensing instrument/technique for ocean surface salinity measurements from aircraft. Goal: to improve measurement accuracy to ` order of magnitude better than available in FY98. The ultimate goal is the capability to globally measure sea surface salinity from space (0Y19). Continue to improve the design and sophistication of a global climate system model, including use of higher resolution, to make it a state-of-the-art climate system model for projecting the climatic consequences at the regional level. Improvement will be manifested in increased resolution from added computing power and better numerical representations (0Y20).		
Assessment		0Y19 and 0Y20 were green		

***New objectives have been developed for FY 2002. The targets can be mapped to the following new objectives:**

Objective (1A): Discern and describe how the Earth is changing.
Objective (1B): Identify and measure the primary causes of change in the Earth system.
Objective (1C): Determine how the Earth system responds to natural and human-induced changes
Objective (1D): Identify the consequences of change in the Earth system for human civilization.
Objective (IE): Enable the prediction of future changes in the Earth system.

FY 99-01 Strategic Objective: Understand the causes of variation in atmospheric ozone concentration and distribution

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	TOMS data will be used for new retrieval methods to collect and analyze three new data products, including surface ultraviolet, tropospheric aerosols, and tropospheric columns. With SBUV/2 data, TOMS will make a continuous 20-year data set for total ozone-measuring effectiveness of Montreal Protocol. New and extended data products will be made available on TOMS web site. (Y12). Complete initiation of the full Southern Hemisphere Additional Ozonesonde network to obtain the first-ever climatology of upper tropospheric ozone in the tropics (Y14).	Implement the SAGE III Ozone Loss and Validation Experiments. Measurements will be made from October 1999 to March 2000 in the Arctic/high-latitude region from the NASA DC-8, ER-2, and balloon platforms. Will acquire correlative data to validate SAGE III data and assess high-latitude ozone loss (0Y22). (Green) Complete the analysis and publication of the PEM-Tropics-B field experiment (0Y23). (Green) Complete the Troposphere Chemistry aircraft instrument size and weight reductions (by ~40%) initiative (0Y24). (Green)	Increase understanding of the dynamics of atmospheric composition by developing, analyzing, and documenting multi-year data sets and meeting at least 4 of 5 performance indicators in this research area (1Y9). Explain the dynamics of atmospheric chemistry by building improved models and prediction capabilities and meeting at least 2 of 3 performance indicators in this research area (1Y10).	Increase understanding of stratospheric ozone changes, as the abundance of ozone-destroying chemicals decreases and new substitutes increases by meeting 2 of 2 performance indicators (2Y4). Increase understanding of trends in atmospheric constituents and solar radiation and the role they play in driving global climate by meeting at least 3 of 4 performance indicators (2Y7). Increase understanding of stratospheric trace constituents and how respond to change in climate and atmospheric composition by meeting 2 of 2 performance indicators (2Y13).
Assessment	Yellow due to Russian implementation delay	All were green.	TBD	TBD

FY 99-01 Strategic Objective: Understand the causes of variation in atmospheric ozone concentration and distribution (cntinued)

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	With data from other atmospheric ozone programs, continue the detailed multi-aircraft study of troposphere chemistry over the tropical Pacific Ocean, especially the contribution of long-range transport of air from South America and Africa to unpolluted areas. Complete the field measurements phase of PEM-Tropics-B (rainy season) with an improved payload that has resulted from an initiative to develop a smaller, lighter payload with equal or better performance than PEM-Tropics-A (dry season). Results will be fully analyzed and published. (Y15).	Complete the planning for major new 2001 airborne/unmanned aerospace vehicle mission that will use a smaller Troposphere Chemistry aircraft instrument (0Y25).		Increase understanding of the effects of regional pollution on the global atmosphere, and the effects of global chemical and climate changes on regional air quality by meeting at least 4 of 5 performance indicators (2Y15). Increase understanding of the extent that future atmospheric chemical impacts on ozone and climate can be predicted by meeting at least 2 of 3 performance indicators (2Y22).
Assessment	Yellow due to Russian implementation delay	Green		TBD

FY 99-01 Strategic Objective: Understand the causes of variation in atmospheric ozone concentration and distribution (continued)

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	Use SAGE III to improve the collection and analysis of measurements provided by SAGE II, and add: nitrogen trioxide and chlorine dioxide measures; additional wavelength sampling to directly measure and retrieve aerosols throughout the troposphere; and, higher spectral resolution (Y13). With data from other atmospheric ozone programs, measure surface levels of chlorine- and bromine-containing chemical compounds addressed in the Montreal Protocol to document decreasing concentrations of regulated compounds and increasing concentrations of replacement compounds. Analyses will be provided to researchers supporting the WMO assessment process. (Y16).			
Assessment	Yellow due to Russian implementation delay			

FY 2002 Enterprise-Wide Supporting Activities/FY 99-01 Objective: Successfully launch spacecraft

	FY 1999	FY 2000	FY 2001	FY 2002
APG #	The Enterprise will successfully launch three spacecraft within 10% of budget on average (Y35).	Launch three spacecraft and deliver two instruments for international launches within 10% of budget on average (0Y36).	Successfully develop, have ready for launch, and operate instruments on a least two spacecraft within 10 percent of their schedules and budget to enable Earth Science research and applications goals and objectives (1Y1).	Successfully develop, have ready for launch, and operate instruments on at least two spacecraft to enable Earth Science research and applications goals and objectives (2Y29).
Assessment	Yellow	Green	TBD	TBD

FY 2002 Enterprise-Wide Supporting Activities/FY 99-01 Objective: Implement open, distributed, and responsive data system architectures

	FY 1999	FY 2000	FY 2001	FY 2002
APG #	Make available data on prediction, land surface, and climate to users within 5 days (Y17). Increase the volume of data archived by 10% compared to FY97 (target = 139 terabytes). Goddard has been collecting trend data since FY94. (Y18). Increase the number of distinct customers by 20% compared to FY97 (target = 839,000). Goddard has been collecting trend data since FY94 (Y19). Increase products delivered from the DAACs by 10% compared to FY97 (target = 3.8 million). Goddard has been collecting trend data since FY94 (Y20).	EOSDIS make available data on prediction, land surface, and climate to users within five days (0Y26). EOSDIS will double the volume of data archived compared to FY98 (0Y27). EOSDIS will increase the number of distinct customers by 20% compared to FY98 (0Y28). EOSDIS will increase products delivered from the DAACs by 10% compared to FY98 (0Y29).	Successfully disseminate Earth Science data to enable our science research and applications goals and objectives by meeting all performance indicators in this research area (1Y2).	Successfully disseminate Earth Science data to enable our science research and applications goals and objectives. Success will equate to meeting 4 of 5 performance indicators (2Y30). Safely operate airborne platforms to gather remote and in situ earth science data for process and calibration/validation studies (2Y31).
Assessment	Blue	All were blue.	TBD	TBD

Objective: Stimulate public interest in and understanding of Earth system science and courage young scholars to consider careers in science and technology/FY 99-01 Objective: Increase public understanding of Earth system science through education and outreach.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	Award 50 new graduate student research grants and 20 early career postdoctoral fellowships in Earth Science. (Y21). Conduct over 300 teacher workshops to train teachers in use of Earth Science Enterprise education products (Y22). Increase number of schools participating in GLOBE from to 8,000, from 5,900 in FY98, a 35-percent increase; increase participating countries from 70 in FY98 to 72 (Y23).	Award 50 new graduate student research grants and 20 early career fellowships in Earth Science (0Y30). Conduct at least 300 workshops to train teachers in use of ESE education products (0Y31). Increase number of schools participating in GLOBE to 10,500, a 30% increase over FY99; increase participating countries to 77 (from 72). (0Y32).	Increase public understanding of Earth system science through formal and informal education by meeting at least 3 of 4 performance targets in this area (1Y18).	Share NASA's discoveries in Earth science with the public to enhance understanding of science and technology (2Y24).
Assessment	Green	0Y30 was green. 0Y31 was blue. 0Y32 was yellow.	TBD	TBD

Objective: Develop advanced technologies to reduce the cost and expand the capability for scientific Earth observation/FY 99-01 Objective: Develop and transfer advanced remote-sensing technologies.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	Annually advance at least 25% of funded instrument technology developments one TRL (Y30). Demonstrate a new capability to double the calibration quality for moderate-resolution land imagery. (Y28). Annually transfer at least one technology development to a commercial entity for operational use (Y29).	Advance at least 25% of funded instrument technology development one TRL to enable future science missions and reduce their total cost (0Y35). Achieve a 50% reduction in mass for future land imaging instruments (0Y33). Transfer at least one technology development to a commercial entity for operational use (0Y34).	Achieve success with timely development and infusion of technologies. Enable future science missions by increasing technology readiness for mission concepts to reduce their total cost. Do this by meeting at least 3 of 4 performance indicators for this advanced technology area (1Y13).	Successfully develop and infuse technologies that will enable future science measurements, and/or improve performance and reduce the cost of existing measurements. Increase the readiness of technologies under development, advancing them to a maturity level where they can be infused into new missions with shorter development cycles (2Y25).
Assessment	Green	0Y35 was blue 0Y33 and 0Y34 were green	TBD	TBD

Objective: Develop advanced information systems for processing, archiving, accessing, visualizing, and communicating Earth science data.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				Develop hardware/software tools to demonstrate high-end computational modeling to further our understanding and ability to predict the dynamic interaction of physical, chemical and biological processes affecting the earth (2Y26). Develop baseline suite of multidisciplinary models and computational tools leading to scalable global climate simulations. (2Y27)
Assessment				TBD

Objective: Demonstrate scientific and technical capabilities to enable the development of practical tools for public and private-sector decision makers/FY 99-01 Strategic Objective: Extend the use of Earth Science research for regional, state, and local applications

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	Establish at least five Regional Earth Science Applications Centers (RESACs) (Y31). Complete solicitation for seven co-operative agreements with State and local governments in areas of land use planning, land capability analysis, critical areas management, and water resource management (Y33). Establish at least eight new projects, with USDA, in the areas of vegetation mapping and monitoring, risk and damage assessment, resources management and precision agriculture (Y32).	At least one of seven Regional Earth Science Applications Center (RESAC) becomes self-sustaining. Continue funding for the remaining centers (0Y41). Develop two new validated commercial information products as a result of verification and validation partnerships with industry (0Y46). Implement at least five joint applications research projects/partnerships with State and local governments in remote – sensing applications (0Y43).	Provide regional decision-makers with scientific and applications products/tools by meeting at least 7 of 8 performance indicators for this applications research area (1Y14). Improve access to and understanding of remotely sensed data and processing technology by meeting 3 of 3 performance indicators in this area (1Y15).	Provide regional decision-makers with scientific and applications products and tools (2Y23).
Assessment	Blue	0Y41 was yellow 0Y46 and 0Y43 were green	TBD	TBD

Objective: Partner with other agencies to develop and implement better methods for using remotely sensed observations in Earth system monitoring and prediction/FY 99-01 Strategic Objective: Extend the use of Earth Science research for regional, state, and local applications.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				Collaborate with other Federal and international agencies in developing and implementing better methods for using remotely sensed observations (2Y28)
Assessment				TBD

FY 99-01 Objective: Support the development of a robust commercial remote sensing industry

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	Establish at least 75 commercial partnerships in "value-added" remote sensing product development; an increase from 37 over FY97 (Y34).	Focus EOCAP joint commercial applications research to develop 20 new market commercial products (e.g., oil spill containment software by EarthSat and map sheets products by ERDAS, Inc.). (0Y44). Provide three commercial sources of science data (from the data buy) for global change research and applications (0Y45). Develop two new validated commercial information products as a result of verification and validation partnerships with industry (0Y46).	Stimulate the development of a robust commercial remote sensing industry by meeting at least 4 of 5 performance indicators in this area (1Y16). Increase efficiencies in food and fiber production with the aid of remote sensing by meeting the performance indicator in this area (1Y17).	
Assessment	Blue	0Y44 was yellow 0Y45 and 0Y46 were green	TBD	

FY 99-01 Strategic Objective: Make major scientific contributions to national and international environmental assessments

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	Make significant contribution to World Meteorological Organization (WMO) Ozone Assessment by providing a lead chapter author and most of the global-scale data (Y26). Contribute model results of climate affects of measured aircraft emissions and provide report to IPCC assessment report (Y24). Make significant contributions to US. Regional/national assessments in partnership with U.S. Global Change Research Program agencies (Y25). Provide lead chapter author and most of the global-scale data and contributing researchers to the IPCC Assessment Report, sponsored by the United Nations Environment Programme and WMO (Y27).	Sponsor two regional national assessment studies of environmental variations and natural resources vulnerability (0Y48). (Green) Complete the contribution to the First National Assessment of the Potential Consequences of Climate Variability and Change: provide climate scenario information, support the national synthesis, conduct several regional U.S. analyses, and provide supporting research for sector analyses. Provide information to the U.S. National Assessment Coordination Office. (0Y5). (Green)	Note: incorporated into science objectives in FY01 and beyond	
Assessment	Green	Green		

FY 99-01 Strategic Objective: Make major scientific contributions to national and international environmental assessments (continued)

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		Conduct the first regional international assessment in South Africa: quantify the effects of climate variability and management practices on the environment, publish in open literature, and provide analyses to IPCC for their 2000 assessment. (0Y6). Provide the first global, regional and country-by country forest cover inventory in support of national and international needs research, operational and policy communities. Publish and provide to IPCC and the International Geosphere-Biosphere Programme for their 2000 assessment report (0Y8).		
Assessment		0Y6 was yellow. 0Y8 was green.		

Earth Science Enterprise FY 2002	Budget Category	Earth Observing System	Earth Explorers	Operations	Research and Technology	Investments
2Y1: Increase understanding of global precipitation, evaporation and how the cycling of water is changing by meeting at least 3 of 4 performance indicators.		X		X	X	
2Y2: Increase understanding of global ocean circulation and how it varies on interannual, decadal, and longer time scales by meeting 2 of 2 performance indicators.				X	X	
2Y3: Increase understanding of global ecosystems change by meeting at least 3 of 4 performance indicators		X			X	
2Y4: Increase understanding of stratospheric ozone changes, as the abundance of ozone-destroying chemicals decreases and new substitutes increases by meeting 2 of 2 performance indicators.		X		X	X	
2Y5: Increase understanding of change occurring in the mass of the Earth's ice cover by meeting at least 3 of 4 performance indicators.		X	X		X	
2Y6: Increase understanding of the motions of the Earth, the Earth's interior, and what information can be inferred about the Earth's internal processes by meeting at least 4 of 5 performance indicators.			X		X	
2Y7: Increase understanding of trends in atmospheric constituents and solar radiation and the role they play in driving global climate by meeting at least 3 of 4 performance indicators.		X			X	
2Y8: Increase understanding about the changes in global land cover and land use and their causes by meeting at least 2 of 3 performance indicators.		X			X	
2Y9: Increase understanding of the Earth's surface and how it is transformed and how such information can be used to predict future changes by meeting at least 4 of 5 performance indicators.		X	X		X	

Earth Science Enterprise FY 2002	Budget Category	Earth Observing System	Earth Explorers	Operations	Research and Technology	Investments
2Y10: Increase understanding of the effects of clouds and surface hydrologic processes on climate change by meeting at least 4 of 5 performance indicators.		X			X	
2Y11: Increase understanding of how ecosystems respond to and affect global environmental change and affect the global carbon cycle by meeting at least 4 of 5 performance indicators.		X		X	X	
2Y12: Increase understanding of how climate variations induce changes in the global ocean circulation by meeting at least 4 of 6 performance indicators.		X			X	
2Y13: Increase understanding of stratospheric trace constituents and how they respond to change in climate and atmospheric composition by meeting 2 of 2 performance indicators.				X	X	
2Y14: Increase understanding of global sea level and how it is affected by climate change by meeting at least 2 of 3 performance indicators.					X	
2Y15: Increase understanding of the effects of regional pollution on the global atmosphere, and the effects of global chemical and climate changes on regional air quality by meeting at least 4 of 5 performance indicators.		X		X	X	
2Y16: Increase understanding of variations in local weather, precipitation and water resources and how they relate to global climate variation by meeting 2 of 2 performance indicators.		X		X	X	
2Y17: Increase understanding of the consequence of land cover and land use change for the sustainability of ecosystems and economic productivity by meeting at least 2 of 3 performance indicators.		X			X	

Earth Science Enterprise FY 2002	Budget Category	Earth Observing System	Earth Explorers	Operations	Research and Technology	Investments
2Y18: Increase understanding of the consequences of climate and sea level changes and increased human activities on coastal regions by meeting 2 of 2 performance indicators.		X			X	
2Y19: Increase understanding of the extent that weather forecast duration and reliability can be improved by new space-based observations, data assimilation and modeling by meeting at least 2 of 3 performance indicators.				X	X	
2Y20: Increase understanding of the extent that transient climate variations can be understood and predicted by meeting at least 4 of 5 performance indicators.		X		X	X	
2Y21: Increase understanding of the extent that long-term climate trends can be assessed or predicted by meeting at least 4 of 5 performance indicators.					X	
2Y22: Increase understanding of the extent that future atmospheric chemical impacts on ozone and climate can be predicted by meeting at least 2 of 3 performance indicators.					X	
2Y23: Provide regional decision-makers with scientific and applications products and tools.					X	
2Y24: Share NASA's discoveries in Earth science with the public to enhance understanding of science and technology.					X	
2Y25: Successfully develop and infuse technologies that will enable future science measurements, and/or improve performance and reduce the cost of existing measurements. Increase the readiness of technologies under development, advancing them to a maturity level where they can be infused into new missions with shorter development cycles.					X	

Earth Science Enterprise FY 2002	Budget Category	Earth Observing System	Earth Explorers	Operations	Research and Technology	Investments
2Y26: Develop hardware/software tools to demonstrate high-end computational modeling to further our understanding and ability to predict the dynamic interaction of physical, chemical and biological processes affecting the earth.					X	
2Y27: Develop baseline suite of multidisciplinary models and computational tools leading to scalable global climate simulations by meeting at least 2 of 3 performance indicators.					X	
2Y28: Collaborate with other Federal and international agencies in developing and implementing better methods for using remotely sensed observations.					X	
2Y29: Successfully develop, have ready for launch, and operate instruments on at least two spacecraft to enable Earth Science research and applications goals and objectives.		X	X		X	
2Y30: Successfully disseminate Earth Science data to enable our science research and applications goals and objectives. Success will equate to meeting 4 of 5 performance indicators.		X			X	
2Y31: Safely operate airborne platforms to gather remote and in situ earth science data for process and calibration/validation studies.					X	

Human Exploration and Development of Space Enterprise (HEDS)

Mission

As we enter a new millennium, people the world over are reflecting on the accomplishments of the past and speculating about opportunities of the future. Some of the most inspiring and important accomplishments of the past four decades have resulted from the space program: events such as the planet-wide impact of the Apollo landings on the moon and images of the Earth; discoveries such as the astonishing Hubble Space Telescope (HST) photos of solar system formation; achievements such as the sending of the first human spacecraft—Pioneer and Voyager spacecraft—beyond our solar system; and new capabilities such as communications and weather satellites. Space has touched the lives of many hundreds of millions worldwide.

The mission of HEDS is to expand the frontiers of space and knowledge by exploring, using, and enabling the development of space for human enterprise. To achieve this mission, NASA's Human Exploration and Development of Space (HEDS) Enterprise is pursuing four strategic goals:

- Explore the space frontier
- Enable humans to live and work permanently in space
- Enable the commercial development of space, and
- Share the experience and benefits of discovery

We begin with the foundation of the Space Shuttle and the International Space Station, now under construction in Earth orbit, and look to the future by initiating technology development and commercialization in space.

We also aspire to make possible U.S. leadership of international efforts to extend permanently human presence beyond the bounds of Earth, involving both machines and humans as partners in innovative approaches to exploration. We will engage the private sector in the commercial development of space in order to enable the continuation of current space business and the creation of new wealth and new jobs for the U.S. economy.

Accomplishment of these goals will enable historic improvements in our understanding of nature, in human accomplishment, and in the quality of life. The Human Exploration and Development of Space Strategic Plan is a first step. This performance plan shows how we plan to measure our success.

Resource Requirements

(NOA, dollars in millions)

	FY1999	FY 2000	FY 2001	FY 2002
$M	$6,123	$6,259	6,286	6,830
CS FTE	7,209	7,416	7, 936	7,182

Implementation Strategy

Goal 1 - Explore the Space Frontier
There are certain ideas that many believe to be inherent in the human psyche and integral to American culture: ambition for progress, curiosity about the unknown, the need to pose profound questions and to answer them, the concept of new frontiers that—once achieved—promise a better quality of life for all peoples. Space is such a frontier. Earth orbit, the Moon, near-Earth space, Mars and the asteroids, eventually the moons of the giant planets of the outer solar system, and someday more distant worlds—these are collectively the endless, ever-expanding frontier of the night sky under which the human species evolved and toward which the human spirit is inevitably drawn. It is a fundamental goal of NASA to expand the space frontier progressively through human exploration, utilization of space for research, and commercial development.

Strategic Objectives

- Invest in the development of high-leverage technologies to enable safe, effective and affordable human/robotic exploration.*
- Conduct engineering research on the International Space Station to enable exploration beyond Earth orbit.*
- Enable human exploration through collaborative robotic missions.
- Define innovative human exploration mission approaches.*
- Develop exploration/commercial capabilities through private sector and international partnerships.*

Goal 2 - Enable Humans to Live and Work Permanently in Space
Advances in technology notwithstanding, the human element continues to be the major factor in the success or failure of most terrestrial enterprises. In many cases, innovative technologies are most effective when used to leverage or enhance the productivity of humans. Moreover, the human element is a quintessential component in the public's continuing interest in, and support for the space program. Human presence will be an essential factor in successfully opening the space frontier and expanding knowledge through research in space. As our activities in space grow, so too must human involvement. In this way, we open the door to an array of benefits, tangible and intangible, for the people of the United States and the world. It is, therefore, a goal of NASA to enable and establish permanent and productive human presence in space, to advance America's aspirations and opportunities in space through new technologies and new ways of doing business.

Strategic Objectives

- Provide and make use of safe, affordable, and improved access to space.
- Operate the International Space Station to advance science, exploration, engineering, and commerce.
- Ensure the health, safety, and performance of humans living and working in space.*
- Meet sustained space operations needs while reducing costs.

*Denotes strategic objectives that are not represented with annual performance goals due to the cancellation of the HEDS Technology and Commercialization Initiative based upon a general funding reduction.

Goal 3 - Enable the Commercial Development of Space
Commerce is essential to human society; free market transactions are the foundation of the dramatic progress humankind has made during the past several centuries. Wherever humans go and wherever they live, there too is commerce. Moreover, the free market is an effective mechanism for delivering tangible benefits from space broadly to the American people.

If humanity is to explore and develop space, to better exploit the space environment for profound scientific discoveries, and someday to settle the space frontier, it may be through the continuing expansion of the private sector—of individuals and of industry—into space. As we open the space frontier, we must therefore seek to expand the free market into space.

It is a goal of NASA to enable the commercial development of space.

Strategic Objectives

- Improve the accessibility of space to meet the needs of commercial research and development.
- Foster commercial endeavors with the International Space Station and other assets.
- Develop new capabilities for human space flight and commercial applications through partnerships with the private sector.

Goal 4 - Share the Experience and Benefits of Discovery
Americans—of all backgrounds—should have the opportunity to share in the experience and benefits of space exploration and development. During the past four decades, ambitious human space flight missions have inspired generations of young people to undertake careers in science, mathematics, and engineering— benefiting both themselves and society. The space program can enrich society by directly enhancing the quality of education. Terrestrial applications of technologies developed for space have saved many lives, made possible medical breakthroughs, created countless jobs, and yielded diverse other tangible benefits for Americans. The further commercial development of space will yield still more jobs, technologies, and capabilities to benefit people the world over in their everyday lives. A goal of NASA is therefore to share the experience, the excitement of discovery, and the benefits of human space flight with all.

Strategic Objectives

- Engage and involve the public in the excitement and the benefits of and in setting the goals for the exploration and development of space.
- Provide significantly more value to significantly more people through exploration and space development efforts.
- Advance the scientific, technological, and academic achievement of the Nation by sharing our knowledge, capabilities, and assets.

Performance Measures

Goal 1: Explore the Space Frontier

Objective: Enable human exploration through collaborative robotic missions.

Public Benefit: A better understanding (at the earliest possible dates) of the space and planetary environments to which human explorers will one day travel will make possible a more focused, more effective and lower cost investment to develop the technologies needed for future human/robotic exploration and development of space. This knowledge and understand will also make possible reduced risks to the health and safety of future astronauts. Overall, pursuing collaborative robotic missions will result future human/robotic exploration missions with lower costs and greater benefits that would be otherwise achievable.

Annual Performance Goal 2H03: Provide reliable launch services for approved missions.

- NASA success rate at or above a running average of 95% for missions noted on the Flight Planning Board manifest and launched pursuant to commercial launch service contracts.

Goal 2: Enable Humans to Live and Work Permanently in Space

Objective: Provide and make use of safe, affordable, and improved access to space.

Public Benefit: Successfully meeting goal 2H06 allows researchers to apply the knowledge gained from flying payloads on the Space Shuttle thus assuring a positive return on the public's investment in space transportation

Annual Performance Goal 2H06: Assure public, flight crew, and workforce safety for all Space Shuttle operations, measured by the following:

- Achieve zero type A or B mishaps in FY 2002.
- Achieve an average of 8 or fewer flight anomalies per Space Shuttle mission

Public Benefit: Successfully meeting goal 2H07 allows researchers to apply the knowledge gained from flying payloads on the Space Shuttle thus assuring a positive return on the public's investment in space transportation

Annual Performance Goal 2H07: Safely meet the FY 2002 manifest and flight rate commitment. Annual performance goal is measured for Space Shuttle performance only.

- Achieve 100% on-orbit mission success for all flights in FY 2002. For this metric, mission success criteria are those provided to the prime contractor (SFOC) for purposes of determining successful accomplishment of the performance incentive fees in the contract.

Public Benefit: Ensuring the most effective and efficient access to space for primary payload customers while supporting the safety and reliability of the Shuttle transportation system.

Annual Performance Goal 2H08: Maintain a "12-month" manifest preparation time.

- Baselined Flight Requirements Document (FRD) tracks achievement of this goal and it defines the primary cargo manifest that uses the "12 month" template.

Public Benefit: Ensuring a safe and reliable space transportation system that maximizes long-term benefits to the public through support to the ISS program and other primary payload customers.

Annual Performance Goal 2H09: Have in place a Shuttle safety investment program that ensures the availability of a safe and reliable Shuttle system for ISS assembly and operations.

- Meet the major FY 2002 Space Shuttle Safety Upgrade milestones. For this metric, major milestones are defined to be the Preliminary Design Review dates, Critical Design Review dates, Ready dates for upgrade installation/integration with flight hardware/software, and Ready dates for first flight

Objective: Operate the International Space Station to advance science, exploration, engineering, and commerce.

Public Benefit: Meeting operations targets and beginning research activities will provide many benefits of space research directly to the public through new discoveries and improved technology applications in areas such as medicine, industrial processes and fundamental knowledge.

Annual Performance Goal 2H10: Demonstrate ISS on-orbit vehicle operational safety, reliability, and performance.

- Zero safety incidents (i.e. no on-orbit injuries)

Actual resources available to the payloads measured against the planned payload allocation for power, crew time and telemetry (green = 80% or greater)

Public Benefit: Meeting development targets and beginning research activities will provide many benefits of space research directly to the public through new discoveries and improved technology applications in such areas as medicine, industrial processes and fundamental knowledge.

Annual Performance Goal 2H11: Demonstrate ISS program progress and readiness at a level sufficient to show adequate readiness in the assembly schedule.

- Conduct monthly status reviews to show maturity and preparation of flight readiness products. Maintaining 80% of define activities are within scheduled targets (green)

Public Benefit: Improving life on Earth. Successfully implementing goal 2H12 brings the many benefits of space research directly to the public through new discoveries and improved technology applications in areas such as medicine, industrial processes and fundamental knowledge.

Annual Performance Goal 2H12: Successfully complete 90% of the ISS planned mission objectives.

- Achieve 90% on-orbit mission success for planned ISS assembly and logistics activities on the Space Shuttle flights scheduled for FY 2002. This indicator is determined from the sum total of the successfully accomplished primary mission objectives divided by the total number of mission objectives per year.

Objective: Meet sustained space operations needs while reducing costs.

Public Benefit: The public's investment in space operations demands NASA's attention to safety first and cost reduction whenever possible. We are accountable for maximizing the return on the public's investment.

Annual Performance Goal 2H15: The Space Communications program will conduct tasks that enable commercialization and will minimize investment in government infrastructure for which commercial alternatives are being developed.

- Increase the percentage of the Space Operations budget allocated to the acquisition of communications and data services from the commercial sector from 15% in FY01 to 20% in FY 2002.

Public Benefit: The public's investment in space operations demands NASA's attention to safety first and cost reduction whenever possible. We are accountable for maximizing the return on the public's investment.

Annual Performance Goal 2H16: Performance metrics for each mission will be consistent with detailed program and project operations requirements in project Service Level Agreements

- Achieve at least 95 percent of planned data delivery for space flight missions.

Public Benefit: NASA is undertaking reforms and developing a plan to ensure the future Space Station costs will remain within the President's FY2002 Budget plan.

Annual Performance Goal 2H19: Develop and execute a management plan and open future Station hardware and service procurements to innovation and cost-saving ideas

•Implement management plan – The ISS Management Action Plan (PMAP) addresses the cost and management challenges/risks in OMB, GAO and OIG reports. It contains reforms that strengthen headquarters involvement, increases communications, provide more accurate assessment and maintains budget accountability.

Goal 3: Enable the Commercial Development of Space

Objective: Improve the accessibility of space to meet the needs of commercial research and development.

Public Benefit: Promote continuous research and development activities through the International Space Station assembly period.

Annual Performance Goal 2H17: Provide an average of five mid-deck lockers on each Space Shuttle mission to the International Space Station for research.

- Demonstrate that an average of five mid-deck lockers were used to support research on Space Shuttle Mission going to the ISS (source Space Station manifest).

Public Benefit: New commercially developed launch services will be able to compete for NASA launches when they meet NASA's risk mitigation policy.

Annual Performance Goal 2H18: Establish mechanisms to enable NASA access to the use of U.S. commercially developed launch systems.

- NASA launch service contracts in place or planned with annual on-ramps for newly developed commercial launch services as they meet NASA's risk mitigation policy.

Objective: Foster commercial endeavors with the International Space Station and other assets.

Public Benefit : By enabling and facilitating commercial activities, HEDS activities will be more inclusive and receptive to new participants and ideas. For example, this infusion will enhance ISS as a scientific research and technology development platform while offsetting implementation costs and increasing public access and awareness.

Annual Performance Goal 2H26 - Increase collaboration in space commerce with a variety of industry, academia and non-profit organizations

• Materially participate in the development and issuance of a NASA-wide enhanced space commerce strategy document; and produce formal documents that demonstrate serious potential collaboration with at least three private sector companies

Public Benefit: Progress in implementing 2H21 will transition NASA to the Research and Development (R&D) organization that was envision as its primary responsibility over 40 years ago. Partnership with commercial investors brings the results and benefits of living and working in space to the public more quickly than the government could do by itself.

Annual Performance Goal 2H21 - Continue implementation of planned and new privatization efforts and further efforts to safely and effectively transfer civil service positions and responsibilities to private industry.

- Negotiate an extension of the Space Flight Operations Contract (SFOC) by the end of the fiscal Year.

- Develop criteria and establish options with private industry on shuttle privatization that assures continued safe operation of the Space Shuttle. Engage aerospace contractor community in evaluation of options.

Goal 4: Share the Experience and Benefits of Discovery

Objective: Provide significantly more value to significantly more people through exploration and space development efforts.

Public Benefit: Continuing to improve public involvement in the conduct of and results from future HEDS activities will assure that future exploration and development of space programs are well understood by the primary constituents for NASA exploration programs. In addition, more effective communication of the knowledge and technologies resulting from HEDS activities will assure the more rapid transition of these innovations into private sector applications, with resulting benefits to the economy and quality of life.

Annual Performance Goal 2H24: Expand public access to HEDS missions information (especially ISS) by working with industry to create media projects and public engagement initiatives that allow "first-hand" public participation using telepresence for current missions, and virtual reality or mock-ups for future missions beyond Earth orbit.

- Museums – track the number of science museums and other informal education forums incorporating first person participation with the ISS.
- Public Web presence – track number and duration of visits to the HEDS website

Objective: Advance the scientific, technological, and academic achievement of the Nation by sharing our knowledge, capabilities, and assets.

Public Benefit: HEDS is an important investment in the future of the US. By presenting and disseminating informational and educational materials on HEDS, including new discoveries, in a form that is accurate and current, understandable to both educators and students, and tied to local, state, and national curriculum frameworks, HEDS can contribute to advancing the academic achievements of the Nation. Similarly, by effectively advancing scientific and technological achievements, new discoveries and new industries will result, contributing to a stronger economy in the future.

Annual Performance Goal 2H28: Initiate the development and implementation of a formal and systematic mechanism to integrate HEDS latest research knowledge into the K-12/University classroom environment.

- Research and develop products, services, and distance learning methodologies that facilitate the application of technology to enhance the educational process for formal and informal education and lifelong learning.

Verification and Validation

Internal Assessment

Interim evaluation and monitoring of performance targets will be conducted, as required, as an element of regular meetings of the Office of Space Flight and HEDS Management Boards. As a matter of NASA policy, relevant HEDS performance targets are included in the HEDS portion of the NASA's performance plans submitted by the Associate Administrator of the Office of Space Flight.

Final data collection, reporting and verification for inclusion in the Annual Performance Report will rely on several different processes depending on the particular Annual Performance Goal. Wherever possible, a specific tangible product has been identified in the indicator for individual performance goals to strengthen the validation process.

For many HEDS performance goals, (e. g. Space Shuttle in-flight anomalies, Space Station assembly milestones) verification of performance is straightforward and progress is monitored through regular management channels and reports.

External Assessment

To assist in evaluating those performance goals that are more difficult to associate with specific tangible products, HEDS will employ an annual external assessment process. An OSF Advisory Committee reviews and evaluates OSF performance targets.

MULTI-YEAR PERFORMANCE TREND

Human Exploration and Development of Space Enterprise (HEDS)

Invest in the development of high-leverage technologies to enable safe, effective, and affordable human/robotic exploration.

	FY 1999	**FY 2000**	**FY 2001**	**FY 2002**
Explore the Space Frontier		0H38: In coordination with other Enterprises, develop and implement tests and demonstrations of capabilities for future human exploration in the areas of advanced space power, advanced space transportation, information and automation systems, and sensors and instruments.	1H32: Initiate the HEDS Technology/Commercialization program and establish a synergistic relationship with industry.	
Assessment	N/A	Yellow		

Enable human exploration through collaborative robotic missions

	FY 1999	FY 2000	FY 2001	FY 2002
Explore the Space Frontier		OH35: Complete the integration and testing of the Mars In-situ Propellant Production Precursor (MIP) flight unit for the 2001 Mars Surveyor mission.	1H1: Complete testing and delivery for spacecraft integration of experiments for the Mars Surveyor Program 2001 missions.	
Assessment		Red	TBD	
Explore the Space Frontier				2H3: Provide reliable launch services for approved missions. • NASA success rate at or above a running average of 95% for missions noted on the Flight Planning Board manifest and launched pursuant to commercial launch service contracts.
Assessment				TBD

Provide and make use of safe, affordable and improved access to space.

Enable Humans to live and Work Permanently in Space	9H15: Achieve seven or fewer flight anomalies per mission	0H12: Achieve seven or fewer flight anomalies per mission	1H7: Achieve 8 or fewer flight anomalies per mission.	2H6: Assure public, flight crew, and workforce safety for all Space Shuttle operations, measured by the following: • Achieve zero type A or B mishaps in FY 2002. • Achieve an average of 8 or fewer flight anomalies per Space Shuttle mission
Assessment	Green	Green	TBD	TBD
Enable Humans to live and Work Permanently in Space	9H16: Achieve 85% on time, successful launches, excluding weather risk.	0H13: Achieve 85% on time, successful launches, excluding weather risk. Changed to: Achieve 100% on-orbit mission success.	1H30: Achieve 100% on-orbit mission success	2H7: Safely meet the FY 2002 manifest and flight rate commitment. Annual performance goal is measured for Space Shuttle performance only.
Assessment	Yellow	Green		TBD
Enable Humans to live and Work Permanently in Space	9H17: Achieve a 13-month manifest preparation time.	0H14: Achieve a 12-month manifest preparation time.		2H8: Maintain a "12-month" manifest preparation time.
Assessment	Green	Green		TBD

Provide and make use of safe, affordable and improved access to space.

	FY 1999	FY 2000	FY 2001	FY 2002
Enable Humans to live and Work Permanently in Space	9H18: Achieve a 60% increase in predicted reliability of Space Shuttle over 1995	0H15: Have in place an aggressive Shuttle program that ensures the availability of a safe and reliable Shuttle system through the ISS era.	1H6: Expedite a safety improvement program to ensure the continued safe operations of the Space Shuttle that ensures the availability of a safe and reliable Shuttle system to support Space Station Assembly milestones and operations.	2H09: Have in place a Shuttle safety investment program that ensures the availability of a safe and reliable Shuttle system for ISS assembly and operations.
Assessment	Green	Red	TBD	TBD

Operate the International Space Station to advance science, exploration, engineering and commerce.

Enable Humans to live and Work Permanently in Space		0H61: Conduct operations with a three-person human presence on the ISS.	1H12: Successfully complete the majority of combined ISS planned operations schedules and milestones as represented by permanent human on-orbit operations.	2H10: Demonstrate ISS on-orbit vehicle operational safety, reliability, and performance.
Assessment		Yellow	TBD	TBD
Enable Humans to live and Work Permanently in Space	9H42: Initiate full-scale Multi-Element Integration Testing (MEIT) for elements in the first four launch.		1H10: Successfully complete the majority of the planned development schedules and milestones required to support the Multi-element Integration Testing	2H11: Demonstrate ISS program progress and readiness at a level sufficient to show adequate readiness in the assembly schedule.
Assessment	Green		TBD	TBD

Operate the International Space Station to advance science, exploration, engineering and commerce.

	FY 1999	FY 2000	FY 2001	FY 2002
Enable Humans to live and Work Permanently in Space	9H44: Conduct physical integration of the Z1 Truss launch package and initiate MEIT.			
Assessment	Green			

Operate the International Space Station to advance science, exploration, engineering and commerce.

Enable Humans to live and Work Permanently in Space	9H43: Deliver the U.S. laboratory module to the launch site in preparation for MEIT.	0H16: Deploy and activate the U.S. Laboratory Module to provide a permanent on orbit laboratory capability.		
Assessment	Green	Yellow		
Enable Humans to live and Work Permanently in Space	9H19: Deploy and activate the Russian-built Functional Cargo Block as the early propulsion and control module.	0H18: Deploy and activate the Airlock to provide an ISS-based EVA capability.	1H11: Successfully complete the majority of the ISS planned on-orbit activities such as delivery of mass to orbit and enhanced functionality.	2H12: Successfully complete 90% of the ISS planned mission objectives.
Assessment	Green	Yellow	TBD	TBD
Enable Humans to live and Work Permanently in Space	9H41: Deploy and activate the first U.S.-built element, Unity (Node 1), to provide docking locations and attach ports.	0H17: Deploy and activate the Canadian-built Space Station Remote Manipulator System to provide an ISS-based remote manipulating capability for maintenance and assembly.		
Assessment	Green	Yellow		

Operate the International Space Station to advance science, exploration, engineering and commerce.

	FY 1999	FY 2000	FY 2001	FY 2002
Enable Humans to live and Work Permanently in Space		0H19: Deliver to orbit the first of three Italian-build Multi-Purpose Logistic Modules to provide a reusable capability for delivering payload and systems racks to orbit.		
Assessment		Yellow		
Enable Humans to live and Work Permanently in Space		0H20: Complete preparations for the initial ISS research capability through the integration of the first rack of the Human Research Facility (HRS-1), five EXPRESS racks with small payload research and the Microgravity Science Glovebox (MSG).	1H13: Successfully complete the majority of the planned research activities in support of initiation of on-orbit research opportunities	
Assessment		Yellow	TBD	
Enable Humans to live and Work Permanently in Space			1H14: Successfully complete no less than 85% of the planned Russian Program Assurance schedules and milestones required for the development of the Propulsion Module.	
Assessment			TBD	

Operate the International Space Station to advance science, exploration, engineering and commerce.

	FY 1999	FY 2000	FY 2001	FY 2002
Enable Humans to live and Work Permanently in Space		0H22: Complete the production of the X-38 first space flight test article in preparation for a Shuttle test flight in 2001.	1H15: Successfully complete no less than 75% of the planned crew return capability schedules. FY01 indicators will include accomplishment of program schedule milestones for Phase 1 development Of a crew return vehicle (CRV) that could provide the U.S. crew return capability.	
Assessment		Yellow	TBD	

Meet sustained space operations needs while reducing costs.

	FY 1999	FY 2000	FY 2001	FY 2002
Enable Humans to live and Work Permanently in Space	9H30: Complete the development of a commercialization plan for the ISS and the Space Shuttle in partnership with the research and commercial communities, and define and recommend policy and legislative changes.	0H39: Promote privatization of Space Shuttle operations and reduce civil service resource requirements for operations by 20% (from the FY 1996 FTE levels) in FY 2000.		
	Yellow	Red		
Enable Humans to live and Work Permanently in Space	9H34: Develop options and recommendations to commercialize space communications.	0H42: Increase the expenditures for commercial services to 10% of the total space communications budget by FY 2000.	1H20: Increase the percentage of the space operations budget allocated to acquisition of communications and data services from the commercial sector to 15%.	2H15: The Space Communications program will conduct tasks that enable commercialization and will minimize investment in government infrastructure for which commercial alternatives are being developed.
Assessment	Red	Green	TBD	TBD

Enable Humans to live and Work Permanently in Space		0H40: Promote privatization and commercialization of Space Shuttle payload operations through the transition of payload management functions (payload integration managers, payload officers, etc.) by FY 2000.	1H21: Achieve at least 95 percent of planned data delivery from space flight missions as documented in space, ground, deep space, and NASA integrated service networks performance metrics consistent with detailed program and project operations requirements in project service level agreements.	2H16: Performance metrics for each mission will be consistent with detailed program and project operations requirements in project Service Level Agreements • Achieve at least 95 percent of planned data delivery for space flight missions.
Assessment		Green	TBD	TBD

Meet sustained space operations needs while reducing costs.

	FY 1999	**FY 2000**	**FY 2001**	**FY 2002**
Enable Humans to live and Work Permanently in Space		0H41: Within policy limitations and appropriate waivers, pursue the commercial marketing of Space Shuttle payloads by working to allow the Space Flight Operations Contractor to target two reimbursable flights, one in FY 2001 and one in FY 2002.		
Assessment		No longer applicable - see 2000 Performance Report		
Enable Humans to live and Work Permanently in Space	9H33: Reduce space communications operations costs by 30 to 35% compared to the FY96 budget, through a consolidated space communications contract to meet established budget targets.	0H43: Reduce the space communications budget submit for FY 2000 by 30-35% from the FY 1996 congressional budget submit.		
Assessment	Green	Green		

Meet sustained space operations needs while reducing costs.

Enable Humans to live and Work Permanently in Space				2H19: Develop and execute a management plan and open future Station hardware and service procurements to innovation and cost-saving ideas.
Assessment				TBD

Improve the accessibility of space to meet the needs of commercial research and development.

Enable the Commercial Development of Space				2H17: Provide an average of five mid-deck lockers on each Space Shuttle mission to the International Space Station for research.
Assessment				TBD

Improve the accessibility of space to meet the needs of commercial research and development.

	FY 1999	**FY 2000**	**FY 2001**	**FY 2002**
Enable the Commercial Development of Space				2H18: Establish mechanisms to enable NASA access to the use of U.S. commercially developed launch systems.
Assessment				TBD

Foster commercial endeavors with the International Space Station and other assets.

Enable the Commercial Development of Space				2H26 Increase collaboration in space commerce with a variety of industry, academia and non-profit organizations.
Assessment				TBD

Develop new capabilities for human space flight and commercial applications through partnerships with the private sector

	FY 1999	FY 2000	FY 2001	FY 2002
Enable the Commercial Development of Space		0H44 Invest 25% of the space communications technology budget by FY 2000 in projects that could enable space commercial opportunities, including leveraging through a consortium of industry, academia, and Government.		
Assessment		Green		

Develop new capabilities for human space flight and commercial applications through partnerships with the private sector

	FY 1999	FY 2000	FY 2001	FY 2002
Enable the Commercial Development of Space			1H23: Foster commercial endeavors by reviewing and/or implementing new policies and plans, such as the Space Station resource pricing policy and intellectual property rights policy. Ensure that Space Station resources allocated to commercial research are utilized by commercial partners to develop commercial products and improve industrial processes.	
Assessment			TBD	

Advance the scientific, technological, and academic achievement of the Nation by sharing our knowledge, capabilities and assets.

	FY 1999	FY 2000	FY 2001	FY 2002
Share the experience and benefits of discovery.				2H28: Initiate the development and implementation of a formal and systematic mechanism to integrate HEDS latest research knowledge into the K-12/University classroom environment.
Assessment				

Develop new capabilities for human space flight and commercial applications through partnerships with the private sector

	FY 1999	FY 2000	FY 2001	FY 2002
Enable the Commercial Development of Space				2H21: Continue implementation of planned and new privatization efforts and further efforts to safely and effectively transfer civil service positions and responsibilities to private industry.
Assessment				TBD

Provide significantly more value to significantly more people through exploration and space development efforts.

	FY 1999	FY 2000	FY 2001	FY 2002
Share the Experience and Benefits of discovery				2H24: Expand public access to HEDS missions information (especially ISS) by working with industry to create media projects and public engagement initiatives that allow "first-hand" public participation using telepresence for current missions, and virtual reality or mock-ups for future missions beyond Earth orbit.
				TBD

Human Exploration and Development of Space FY 2002	**Budget Category**	Expendable Launch Vehicles and Payloads	Space Communications	Space Shuttle	Space Station
Annual Performance Goal					
2H3: Provide reliable launch services for approved missions.		X			
2H6: Assure public, flight crew, and workforce safety for all Space Shuttle operations, measured by the following: □ Achieve zero type A or B mishaps in FY 2002. □ Achieve an average of 8 or fewer flight anomalies per Space Shuttle mission				X	
2H7: Safely meet the FY 2002 manifest and flight rate commitment. Annual performance goal is measured for Space Shuttle performance only.				X	
2H8: Maintain a "12-month" manifest preparation time.		X			
2H9: Have in place a Shuttle safety investment program that ensures the availability of a safe and reliable Shuttle system for ISS assembly and operations.				X	
2H10: Demonstrate ISS on-orbit vehicle operational safety, reliability, and performance.					X
2H11: Demonstrate ISS program progress and readiness at a level sufficient to show adequate readiness in the assembly schedule.					X
2H12: Successfully complete 90% of the ISS planned mission objectives.					X
2H15: The Space Communications program will conduct tasks that enable commercialization and will minimize investment in government infrastructure for which commercial alternatives are being developed.			X		
2H16: Performance metrics for each mission will be consistent with detailed program and project operations requirements in project Service Level Agreements			X		
2H17: Provide an average of five mid-deck lockers on each Space Shuttle mission to the International Space Station for research.					X

Human Exploration and Development of Space FY 2002	**Budget Category**	Expendable Launch Vehicles and Payloads	Space Communications	Space Shuttle	Space Station
Annual Performance Goal					
2H18: Establish mechanisms to enable NASA access to the use of U.S. commercially developed launch systems.		X			
2H19 Develop and execute a management plan and open future Station hardware and service procurements to innovation and cost-saving ideas.					X
2H21: Continue implementation of planned and new privatization efforts and further efforts to safely and effectively transfer civil service positions and responsibilities to private industry.				X	
2H24: Expand public access to HEDS missions information (especially ISS) by working with industry to create media projects and public engagement initiatives that allow "first-hand" public participation using telepresence for current missions, and virtual reality or mock-ups for future missions beyond Earth orbit.					X
2H26: Increase collaboration in space commerce with a variety of industry, academia and non-profit organizations.		X	X	X	X
2H28: Inititate the development and implementation of a formal and systematic mechanism to integrate HEDS latest research knowledge into the K-12/University classroom environment.				X	X

Aerospace Technology Enterprise

Mission

The Aerospace Technology (AST) Enterprise mission is to pioneer the identification, development, verification, transfer, application, and commercialization of high-payoff aerospace technologies. Research and development programs conducted by the Enterprise contribute to NASA's science and exploration mission, national security, economic growth, and the competitiveness of American aerospace companies. The Enterprise plays a key role in maintaining a safe and efficient national aviation system and enabling an affordable, reliable space transportation system. The Enterprise directly supports national policy in both aeronautics and space as directed in the President's Goals for a National Partnership in Aeronautics and Research Technology, the National Space Policy, and the National Space Transportation Policy.

Implementation Strategy

The Enterprise manages a clearly defined portfolio of technology investments to ensure alignment with national policy, Agency goals, customer requirements, and budget availability. The investment strategies are focused on issues associated with future aviation and space systems. Enterprise objectives are outcome-focused and "stretch" beyond our current knowledge base. The outcome-focused nature of the objectives projects a preferred end-state within the air and space transportation systems. Designated Lead Centers have been assigned the responsibility to manage the implementation and execution phases of the technology programs. Enterprise programs are often conducted in cooperation with other Federal agencies, primarily the Federal Aviation Administration and the Department of Defense. These partnerships take advantage of the national investment in aeronautics and astronautics capabilities and eliminate unnecessary duplication.

The Enterprise supports the maturation of technology to a level such that it can be confidently integrated into current and new systems. In most cases, technologies developed by the Enterprise can be directly transferred to the external customer.

Enterprise Resource Requirements

The President has requested the following budget for FY 1999 to FY 2002 to support the accomplishment of AST goals:

	FY 1999	**FY 2000**	**FY 2001**	**FY 2002**
NOA $M	1,338.9	1,125	1,404	2,508
CS FTE	4,227	4,345	6,170	6,140

Performance Metrics

Goal: Revolutionize Aviation – Enable the safe, environmentally-friendly expansion of aviation.

Objective: Increase Safety – Make a safe air transportation system even safer.

Public Benefit: Improved safety of air travel

Performance Goal 2R1: Complete the interim progress assessment utilizing the technology products of the Aviation Safety program as well as the related Aerospace Base R&T efforts and transfer to industry an icing CD-ROM, conduct at least one demonstration of an aviation safety related subsystem, and develop at least two-thirds of the planned models and simulations. Planned program products that support the accomplishment of the annual performance goal are:

Aerospace Focused – Aviation Safety

- Complete a GA pilot survey.
- Model high error probability contexts and solutions.
- Demonstrate loss of control and recovery models.
- Flight demonstrate forward-looking turbulence warning systems.
- Demonstrate a National Aviation Weather Information Network (AWIN) capability.
- Demonstrate a national AWIN data link capability.
- Validate structural crash analysis tools.
- Complete an interim integrated program assessment.

Aerospace Base R&T

- Develop and distribute a CD-ROM self-paced icing training modules for pilots.
- Develop a methodology for the design and verification of task driven human automation systems.
- Complete validation of new perceptual measurement tools for evaluating display effectiveness as it supports human performance.
- Generate initial model for flight crew Scheduling Assistant based on sleep and circadian cycles.
- Demonstrate prototype technologies for an aviation safety information system
- Assess the electromagnetic impact on critical flight control hardware through physics-based modeling of the Electromagnetic (EM) fields.
- Develop concepts for advanced sensory materials and for embedding sensors into aerospace structural materials.

Objective: Reduce Emissions -- Protect local air quality and our global climate.

Public Benefit: Improved air quality and protection of the environment

Annual Performance Goal 2R2: NASA's research stresses engine technology to reduce the emissions of oxides of nitrogen (NO_x) and carbon dioxide (CO_2). The annual performance goal is to complete sector testing of a low-NO_x combustor concept capable of a 70% reduction in NO_x from the 1996 [International Civil Aviation Organization (ICAO)] baseline, and demonstrate at least one additional concept for the reduction of other emittants. Planned program products that support the accomplishment of the annual performance goal are:

Aerospace Focused – Ultra-Efficient Engine Technology

- Complete sector evaluations of a combustor capable of 70% reductions in Oxides of Nitrogen. Select ceramic thermal barrier coating/process
- Demonstrate aspirating seal technology
- Develop an Integrated Component Demonstration Plan for collaborative tests of engine demonstrators incorporating UEET technologies for large and small thrust class engines.
- Demonstrate durability of a 2200° F Ceramic Matrix Composite (CMC) combustor liner. *(Increase in the budget by Congress)*

Aerospace Base R&T

- Assess hybrid fuel cell and liquid hydrogen fueled optimized turbofan concepts.
- Demonstrate concepts for reduction in gaseous, particulate, and aerosol emissions.
- Identify revolutionary aeropropulsion concepts identified and assess preliminary performance.

Objective: Reduce Noise – Reduce aircraft noise to benefit airport neighbors, the aviation industry, and travelers.

Public Benefit: Improved noise environment in communities near airports

Annual Performance Goal 2R3: NASA's research stresses reducing noise in the areas of engines, nacelles, engine-airframe integration, aircraft interiors and flight procedures. The annual performance goal is to assess and establish the strongest candidate technologies to meet the 10-decibel reduction in community noise. Planned program products that support the accomplishment of the annual performance goal are:

Aerospace Focused – Quiet Aircraft Technology

- Identify community noise impact reduction technology required to meet 10 year, 10 decibel Enterprise goal.
- Deliver initial version of improved aircraft systems noise prediction code delivered.

Objective: Increase Capacity -- Enable the movement of more air passengers with fewer delays.

Public Benefit: Reduced travel time, improved use of natural resources, and protection of the environment

Annual Performance Goal 2R4: NASA's research stresses operations systems for safe, efficient air traffic management and new aircraft configurations for high productivity utilization of existing runways. The annual performance goal is to develop a decision support tool, and define concepts for future aviation systems. Planned program products that support the accomplishment of the annual performance goal are:

Aerospace Focused – Aviation System Capacity

- Develop and evaluate inter-operability of decision support tools that address arrival, surface and departure operations.
- Develop and evaluate a traffic flow management decision support tool for system-wide prediction of sector loading.
- Complete Virtual Airspace System Technology real-time environments definitions and preliminary design.
- Identify candidate future Air Transportation System capacity-increasing operational concepts.
- Complete the Critical Design Review for the Blended Wing Body experimental vehicle.

Objective: Increase Mobility – Enable people to travel faster and farther, anywhere, anytime.

Public Benefit: Increased destinations reachable by air and reduced travel time

Annual Performance Goal 2R5: NASA's research stresses aircraft technologies which enable the use of existing small community and neighborhood airports, without requiring control towers, radar installations, and more land use for added runway protection zones. The annual performance goal is to baseline in partnership with the FAA, the system engineering documents for the Small Aircraft Transportation System concept. Planned program products that support the accomplishment of the annual performance goal are:

Aerospace Focused – Small Aircraft Transportation System

- Complete preparation of the baseline System Engineering documents (including the Operational Requirements Document, Functional Architecture, and Technical Requirements Document) for SATS concept and place under configuration management.

Aerospace Base R&T

- Complete preliminary design of extremely slow takeoff and landing vehicle

Goal: Advance Space Transportation — Create a safe, affordable highway through the air and into space.

Objective: Mission Safety -- Radically improve the safety and reliability of space launch systems.

Public Benefit: Expanded opportunities for near-Earth operations and commercialization through safe and reliable access to space

Annual Performance Goal 2R6: NASA's investments emphasize thorough mission needs development, requirements definition, and risk reduction effort leading to commercially owned and operated launch systems to meet NASA needs with commercial application where possible. The annual performance goal is to complete risk reduction and architecture reviews to support design and demonstration decisions. Planned program products that support the accomplishment of the annual performance goal are:

Aerospace Focused – 2nd Generation RLV
- Conduct Risk Reduction Review.
- Conduct Interim Architecture Review to establish the candidate space transportation architectures.

Objective: Mission Affordability – Create an affordable highway to space.

Public Benefit: Expanded opportunities for near-Earth operations and commercialization through affordable access to space

Annual Performance Goal 2R7**:** NASA's investments emphasize thorough mission needs development, requirements definition, and risk reduction effort leading to commercially owned and operated launch systems to meet NASA needs with commercial application where possible. The annual performance goal is to complete risk reduction and architecture reviews and initial hardware demonstrations to support design and demonstration decisions. Planned program products that support the accomplishment of the annual performance goal are:

Aerospace Focused – 2nd Generation RLV
- Conduct Risk Reduction Review.
- Conduct Interim Architecture Review to establish the candidate space transportation architectures.

Aerospace Base R&T
- Demonstrate advanced adhesives for non-autoclave composite processing.
- Complete Systems Requirements Review on Rocket Based Combined Cycle Demonstrator Engine.
- Demonstrate Reaction Transfer Molded Polymer Matrix Composite with 550°F use temperature.

Objective: Mission Reach – Extend our reach in space with faster travel times.

Public Benefit: Expanded knowledge of the universe and its meaning to life on Earth

Annual Performance Goal 2R8: NASA's long-term research emphasizes innovative propulsions systems. The annual performance goal is to conduct a test of an advanced ion propulsion engine. Planned program products that support the accomplishment of the annual performance goal are:

Aerospace Base R&T

- Demonstrate > 10 kW operation of a 75 cm. ion engine

Goal: Pioneer Technology Innovation — Enable a revolution in aerospace systems.

Objective: Engineering Innovation -- Enable rapid, high-confidence, and cost efficient design of revolutionary systems.

Public Benefit: Improved productivity of American aerospace workers and their contribution to the national economy

Annual Performance Goal 2R9: NASA's investments emphasize advances in experimental vehicles, flight testbeds, and computing tools to enable revolutionary designs. The annual performance goal is to conduct at least five demonstrations of revolutionary aerospace subsystems. Planned program products that support the accomplishment of the annual performance goal are:

Aerospace Base R&T

- Develop prototype environments that are distributed across heterogeneous platforms, are dynamically extensible, and which support collaborative visualization, analysis, and computational steering.
- Demonstrate improvement in time-to-solution for aerospace applications through high-end computing and end-to-end networking capabilities.
- Develop capability to redesign aerospace vehicles during flight simulations exploiting high-end computing and advanced information management technologies.
- Demonstrate a prototype mishap cause database of space transportation and exploration system missions including the definition of the appropriate taxonomies.
- Demonstrate a highly integrated simulation environment that facilitates the rapid development of future generation electronic devices for PetaFLOPS computing and onboard computing systems for autonomous intelligent vehicles.
- Demonstrate, in production facilities, tools and techniques for high-productivity aerospace test environment.
- Demonstrate automated software verification technology that scales to aerospace software systems.
- Develop system for real-time data acquisition and display of disparate instrumentation types.
- Integrate and demonstrate a Intelligent Flight Control (IFC) into a C-17 simulation.
- Integrate and test at least 4 flight experiments on the F-15B testbed aircraft
- Demonstrate turbo-prop remotely piloted aircraft (RPA) capabilities that exceed the minimum Earth Science Enterprise altitude and duration requirements.
- Demonstrate a viscous, solution-adaptive, unstructured-grid Computational Fluid Dynamics (CFD).
- Develop conceptual high-level autonomy rover architecture.
- Complete a Mars Mission Software Verification Study.
- Complete a case study demonstrating software verification and validation techniques that are applicable to Mars mission software.

- Apply human-centered computing analysis and modeling techniques to evaluate and improve the Mars Exploration Rover (MER) 2003 flight team man-machine system performance for operations and science.

Objective: Technology Innovation -- Enable fundamentally new aerospace system capabilities and missions.

Public Benefit: Continued U.S. competitiveness in the global marketplace, and quality of life from new discoveries

Annual Performance Goal 2R10: NASA's investments emphasize revolutionary technologies such as nanotechnology, information technology and biotechnology that could enable new missions and capabilities. The annual performance goal is to develop at least two new materials concepts and demonstrate the feasibility of at least two nanotechnology and two other concepts. Planned program products that support the accomplishment of the annual performance goal are

Aerospace Base R&T

- Demonstrate feasibility of nanotechnology-based chemical and biosensors and manufacturing approaches of low-power nanoelectronic components.
- Demonstrate aligned carbon nanotubes for polymer matrix material.
- Develop and demonstrate in flight next generation neural flight control
- Demonstrate oscillatory flow control actuators
- Demonstration of Space Communication Link Technology Operating at 622 Mega-bit per second for Direct Space Data Distribution to Users.
- Demonstrate the methodology to produce physics based scaling laws to quantify Reynolds number sensitivities of aerodynamic flow separation on-set and progression
- Demonstrate the ability to dynamically alter the localized flow instabilities over advanced lifting surfaces with micro-adaptive flow control devices.
- Develop concepts for design and analyses of algorithms for control of colonies of fluidic flow control effectors.
- Develop concepts for non-deterministic analyses of advanced composites. including nanotube reinforced polymers to characterize processing uncertainties on material properties.
- Develop concepts for advance sensory materials development and methodologies for imbedding sensors into aerospace structural materials.

Goal: Commercialize Technology — Extend the commercial application of NASA technology for economic benefit and improved quality of life.

Objective: Commercialization — Facilitate the greatest practical utilization of NASA know-how and physical assets by U.S. industry.

Public Benefit: Quality of life from direct aerospace contributions to the U.S. economy, as well as indirect contributions to the fields of medicine and education

Annual Performance Goal 2P7: Dedicate 10 to 20 percent of the Agency's Research and development budget to commercial partnerships. (as noted, this goal is presented in the Provide Aerospace Products and Capabilities section of the plan since it crosscuts all NASA Enterprises)

Annual Performance Goal 2R11: Continue the solicitation of customer feedback on the services, facilities, and expertise provided by the Aerospace Technology Enterprise.

- Achieve a facility utilization customer satisfaction rating of 95 percent at "5" or better using a "10" point scale, and 80 percent "8" or better, based on exit interviews.
- Transfer at least twelve new technologies and processes to industry and other government agencies during the fiscal year.

Annual Performance Goal 2R12: Continue the implementation of current education outreach plans, and establish new plans for all new program activities initiated in FY 2002.

- Implementation examples from current education outreach plans.
- Documented plans for all new program activities initiated in FY 2002

Goal: Space Transportation Management — Provide commercial industry with the opportunity to meet NASA's future launch needs, including human access to space, with new launch vehicles that promise to dramatically reduce cost and improve safety and reliability. (Supports all objectives under the Advance Space Transportation Goal.

Objective: Utilize NASA's Space Transportation Council (STC) in combination with an External Independent Review Team (EIRT) to assure agency-level integration of near and far-term space transportation investments.

Public Benefit: Improved assurance that commercial capabilities and opportunities are appropriately examined in planning and developing new launch vehicle systems

Annual Performance Goal 2R13: Review results of NASA and commercial-sector performed launch system architecture studies, related requirements, and refinements in planned risk-reduction investments.

- Complete an assessment of the Space Launch Initiative architectures and requirements by an External Independent Review Team; the EIRT will submit a written report on their evaluation within 45 days following completion of the review.

- The Space Transportation Council will review progress and planning of the Space Launch Initiative at least twice during the fiscal year, including the report filed by the External Independent Review Team.

Addressing Technology Management Challenges

The overall organizational and management structure of NASA technology development is built around its Strategic Enterprises, including specific program formulation and funding responsibility for all technology activities. This ensures that technology considerations are closely coupled with mission decisions, that technologies are relevant to Enterprise needs, and that mechanisms are provided to transfer successful maturing technologies into operational systems. NASA has undertaken sweeping changes in technology program management to strengthen and highlight the significance of advanced technology in NASA's future. These changes influence how NASA identifies new technology investments, how NASA defines new mission opportunities, and how NASA ensures the efficient transition of new technologies into missions. Overall, the adjustments have resulted in a closer alignment of technology investments with the goals identified in the NASA Strategic Plan.

Coordination and integration among all of the Agency's Enterprises is provided through the NASA Chief Technologist. The Chief Technologist advises the Administrator and other senior officials on matters relating to technology, assures an Agency-wide investment strategy for advanced innovative technology, and is the principal Agency advocate for advanced technology. The Chief Technologist also chairs the Technology Leadership Council, which includes the Associate Administrators for the Strategic Enterprises, the NASA Field Center Directors, the NASA Comptroller, and other senior NASA officials. This Council establishes the technology strategy for the Agency, addresses critical issues, and is responsible for formulating and advancing NASA's vision for technology.

This integrated planning process for technology development is described in detail in the NASA Technology Plan, and reviewed by the Technology and Commercialization Advisory Committee (TCAC), a standing committee of the NASA Advisory Council. The TCAC advises NASA on broad, Agency-wide issues associated with technology and commercialization activities. In addition, each Enterprise supports an advisory committee that is part of the NASA Advisory Council to review its programs and provide recommendations for improvement. These advisory committees include technologists or, in some cases, technology subcommittees to provide special focus on technology activities.

In February 2000, the NASA Administrator merged the Chief Technologist's Office with the Office of Aerospace Technology to better focus the Agency's strategy for maintaining its long-term technology base. The NASA Chief Technologist retains responsibility for serving as the Administrator's principal advisor on Agency-wide technology issues, while also serving as the Associate Administrator for Aerospace Technology. This merger centralized planning and execution of Agency-level technology within one organization while still providing for Enterprise-specific mission technology development by each of the other NASA Enterprises.

Verification/Validation

The Aerospace Technology Enterprise regularly reviews its progress on achieving its performance targets using NASA's established policies and procedures for program and project management. Internal evaluation is provided by the governing Program Management Council, either at the Agency-level or at the designated Lead Center, which meet at least quarterly to execute their

oversight responsibilities. The AST Enterprise also relies on the extensive Safety, Quality, and Reliability processes and Center organizations to assure that performance in our facilities is maintained to standards appropriate for research and technology development operations.

The Aerospace Technology Committee of the NASA Advisory Council also conducts annual assessments of the progress made by the AST Enterprise in achieving its near-term technology objectives. This committee, and its nine technical subcommittees consisting of nearly 150 members from other government agencies, industry and academia that meet two to three times a year, will provide a qualitative progress measurement (Green, Yellow, or Red). "Green" will indicate that the objective was met; "Yellow" will indicate a concern that an objective was not fully accomplished; and "Red" will indicate that events occurred that prevented or severely impaired the accomplishment of the objective. This external assessment includes commentary to clarify and supplement the qualitative measures.

MULTI-YEAR PERFORMANCE TREND

Aerospace Technology Enterprise (OAT)

Increase Safety – Make a safe air transportation system even safer.

	FY 1999	**FY 2000**	**FY 2001**	**FY 2002**
Annual Performance Goal and APG #	9R5: For the aviation safety areas of Controlled Flight into Terrain, runway incursion, and loss of control, identify the contributing causes to be addressed, potential solutions using current capabilities, and gaps that require technology solutions.	'0R3: Flight demonstrate a conceptual aircraft flight deck integrated with evolving ground-based runway incursion avoidance technologies installed at a major airport..	1R1: NASA's research stresses aviation system monitoring and modeling, accident prevention and accident mitigation. The performance target is to complete 75% of the conceptual designs of systems for preventing and mitigating accidents, and to demonstrate tools for accident analysis and risk assessment.	2R1: NASA's research stresses aviation system monitoring and modeling, accident prevention, and accident mitigation. The annual performance goal is to complete the interim progress assessment utilizing the technology products of the Aviation Safety program as well as the related Aerospace Base R&T efforts and transfer to industry an icing CD-ROM, conduct at least one demonstration of an aviation safety related subsystem, and develop at least two-thirds of the planned models and simulations.
Assessment	Green	Yellow	TBD	TBD
Annual Performance Goal and APG #	9R2: Characterize the Super-cooled Large Droplets (SLD) icing environment, determine its effects on aircraft performance, and acquire and publish data to improve SLD forecasting confidence.			
Assessment	Yellow		TBD	TBD

Reduce Emissions -- Protect local air quality and our global climate.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9R1: Demonstrate an advanced turbine-engine combustor that will achieve up to a 50 percent reduction of Oxides of Nitrogen emissions based on 1996 International Civil Aviation Organization (ICAO) standards.	0R1: Demonstrate, in a laboratory combustion experiment, an advanced turbine-engine combustor concept that will achieve up to a 70% reduction of oxides of nitrogen emissions based on the 1996 ICAO standard.	1R2: NASA's research stresses engine technology to reduce the emissions of oxides of nitrogen and carbon dioxide. The performance target is to complete one system level technology benefit assessment, one component concept selection and one new material system.	2R2: NASA's research stresses engine technology to reduce the emissions of oxides of nitrogen (NOx) and carbon dioxide (CO2). The annual performance goal is to complete sector testing of a low-NOx combustor concept capable of a 70% reduction in NOx from the 1996 International Civil Aviation Organization (ICAO) baseline, and demonstrate at least one additional concept for the reduction of other emittants.
Assessment	Green	Blue	TBD	TBD

Reduce Noise – Reduce aircraft noise to benefit airport neighbors, the aviation industry, and travelers.

Annual Performance Goal and APG #		0R2: Validate the technologies to reduce noise for large commercial transports by at least 7 decibels relative to 1992 production technology.	1R3: NASA's research has stressed reducing noise in the areas of engines, nacelles, engine/airframe integration, aircraft interiors and flight procedures. The performance target is completion of NASA's research in noise reduction through large-scale demonstration of a 2-5 decibel reduction in aircraft noise based on 1997 production technology, and initial assessments of concepts offering additional reduction.	2R3: NASA's research stresses reducing noise in the areas of engines, nacelles, engine-airframe integration, aircraft interiors and flight procedures. The annual performance goal is to assess and establish the strongest candidate technologies to meet the 10-decibel reduction in community noise.
Assessment		Green	TBD	TBD

Increase Capacity -- Enable the movement of more air passengers with fewer delays.

Annual Performance Goal and APG #		0R4: Conclude the Terminal Area Productivity project by field demonstrations of the complete suite of technologies and procedures that enable a 12% increase over 1994 nonvisual operations for single-runway throughput.	1R4: NASA's research stresses operations systems for safe, efficient air traffic management and new aircraft configurations for high productivity utilization of existing runways. The performance target is to complete the civil tiltrotor project by validating databases for contingency power, flight paths, and noise reduction, as well as complete at least one demonstration of an airspace management decision support tool.	2R4: NASA's research stresses operations systems for safe, efficient air traffic management and new aircraft configurations for high productivity utilization of existing runways. The annual performance goal is to develop a decision support tool, and define concepts for future aviation systems.
Assessment		Green	TBD	TBD

Increase Mobility – Enable people to travel faster and farther, anywhere, anytime.

Annual Performance Goal and APG #	9R8: Conclude pre-flight ground testing of the general aviation piston and turbofan engines.	0R7: Perform flight demonstrations of advanced general aviation piston and turbine engines at the annual Oshkosh air show.	1R7: NASA's research stresses operations systems for safe, efficient air traffic management and new aircraft configurations for high productivity utilization of existing runways. The performance target is to complete the Advanced General Aviation Transport Experiments project by validating transportation system concepts through flight test and publish design guidelines.	2R5: NASA's research stresses aircraft technologies which enable the use of existing small community and neighborhood airports, without requiring control towers, radar installations, and more land use for added runway protection zones. The annual performance goal is to baseline in partnership with the FAA the system engineering documents for the Small Aircraft Transportation System concept.
Assessment	Yellow	Yellow	TBD	TBD

Increase Mobility – Enable people to travel faster and farther, anywhere, anytime.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9R6: Produce a complete vehicle system configuration document that includes impact of technology validation efforts from 1990 through 1999. This document will support the evaluation of technology selection decisions for a future High Speed Civil Transport (HSCT).			
Assessment	Green			

Mission Safety -- Radically improve the safety and reliability of space launch systems.

Annual Performance Goal and APG #				2R6: NASA's investments emphasize thorough mission needs development, requirements definition, and risk reduction effort leading to commercially owned and operated launch systems to meet NASA needs with commercial application where possible. The annual performance goal is to complete risk reduction and architecture reviews to support design and demonstration decisions.
Assessment				TBD

Mission Affordability – Create an affordable highway to space.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9R14: Continue the X-33 Vehicle Assembly in Preparation for Flight Testing.	0R9: Conduct the flight testing of the X-33 vehicle.	1R10: NASA's research stresses highly reliable, fully reusable configurations, advanced materials and innovative structures. The performance target is complete assembly of the third X-34 test vehicle, demonstrate 75% of supporting technology developments, and complete competitive solicitations for expanded 2nd generation reusable launch vehicle efforts.	2R7: NASA's investments emphasize thorough mission needs development, requirements definition, and risk reduction effort leading to commercially owned and operated launch systems to meet NASA needs with commercial application where possible. The annual performance goal is to complete risk reduction and architecture reviews and initial hardware demonstrations to support design and demonstration decisions.
Assessment	Green	Red	TBD	TBD
Annual Performance Goal and APG #	9R15: Complete Vehicle Assembly and Begin Flight Testing of the X-34.	0R12: Complete vehicle assembly and begin the flight test of the second X-34 vehicle.	1R11: NASA's research stresses technology for reusable, long life, high power electric and advanced, clean chemical engines for earth orbital transfer and breakthrough propulsion, precision landing systems and aero-capture systems for planetary exploration. The performance target is to commence X-37 vehicle assembly, and complete one Pathfinder flight experiment.	
Assessment	Yellow	Red	TBD	

Mission Affordability – Create an affordable highway to space.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0R17: Complete small payload focused technologies and select concepts for flight demonstration of a reusable first stage (Bantam).		
Assessment		Red (project terminated 10/99)		

Mission Reach – Extend our reach in space with faster travel times.

Annual Performance Goal and APG #		0R10: Complete NASA Solar Electric Propulsion Technology Application Readiness (NSTAR) Mission Profile (100% design life) ground testing for Deep Space-1 (concurrent, identical firing of an NSTAR engine in a vacuum chamber with the actual firing sequence of the in-flight propulsion system).		2R8: NASA's long term research emphasizes innovative propulsion systems. The performance target is to conduct a test of an advanced ion propulsion engine.
Assessment		Green		TBD

Engineering Innovation -- Enable rapid, high-confidence, and cost efficient design of revolutionary systems.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9R12: Demonstrate up to a 200-fold improvement over the 1992 baseline (reduction from 3,200 hours to 15) in the time-to-solution for a full combustor simulation on NASA's National Propulsion System Simulation advanced applications computational testbeds that can be increased to sustain teraFLOPS capability.	0R8: Demonstrate a prototype heterogeneous distributed computing environment.	1R8: Develop at least three new design tools, accomplish at least four demonstrations of advances in computation and communications, and complete the intelligent synthesis environment proof-of-concept system capability build to technology readiness level 3.	2R9: NASA's investments emphasize advances in experimental vehicles, flight testbeds, and computing tools to enable revolutionary designs. The annual performance goal is to conduct at least five demonstrations of revolutionary aerospace subsystems.
Assessment	Blue	Green	TBD	TBD
Annual Performance Goal and APG #	9R13: Demonstrate communication testbeds with up to 500-fold improvement over the 1996 baseline (increase from 300 kilobits per second to 150 megabits per second) in end-to-end performance.			
Assessment	Blue			

Engineering Innovation -- Enable rapid, high-confidence, and cost efficient design of revolutionary aerospace systems.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9R10: Complete low-altitude flights of an Remotely Piloted Aircraft (RPA) with a wingspan greater than 200 feet, suitable for flight to 100,000 feet in altitude once outfitted with high-performance solar cells.	0R11: Demonstrate improved remotely piloted aircraft science mission capability by increasing operational deployment time from 3 weeks to 9 with minimum airfield provisions and unrestricted airspace. (Original) Demonstrate continuous over-the-horizon command and control capabilities of an RPA that would extend the operating range from 40 to 200 nautical miles. (Replacement)		
Assessment	Green	Red (orig.); Green (replacement)		
Annual Performance Goal and APG #	9R11: Conduct RPA flight demonstration to validate the capability for science missions of greater than 4 hours duration in remote deployments to areas such as the polar regions above 55,000 feet.			
Assessment	Green			

Engineering Innovation -- Enable rapid, high-confidence, and cost efficient design of revolutionary aerospace systems.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0R6: Demonstrate in flight an airframe-integrated, dual-mode, scramjet-powered vehicle.	1R9: NASA's research stresses affordable flight demonstrations of revolutionary vehicle concepts (low-cost X-Planes) to accelerate technology advances in laboratory research, new design tools and advanced simulation. The performance target is to demonstrate two new concepts in flight and identify five new concepts for further examination.	
Assessment		Yellow	TBD	

Technology Innovation -- Enable fundamentally new aerospace system capabilities and missions.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				2R10: NASA's investments emphasize revolutionary technologies such as nanotechnology, information technology and biotechnology which could enable new missions and capabilities. The annual performance goal is to develop at least two new materials concepts and demonstrate the feasibility of at least two nanotechnology and two other concepts.
Assessment				TBD

Commercialization — Facilitate the greatest practical utilization of NASA know-how and physical assets by U.S. industry.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9R16: Complete 90 percent of all Enterprise-controlled milestones within 3 months of schedule.	0R13: Complete 90 percent of all Enterprise-controlled milestones within 3 months of schedule.		
Assessment	Yellow	Red		
Annual Performance Goal and APG #	9R17: Achieve a facility utilization customer satisfaction rating of 95 percent of respondents at "5" or better and 80 percent at "8" or better based on exit interviews.	0R14: Achieve a facility utilization customer satisfaction rating of 95% of respondents at "5" or better and 80% at "8" or better, based on exit interviews.		
Assessment	Blue	Green		
Annual Performance Goal and APG #	9R18: Complete the Triennial Customer Satisfaction Survey, and achieve an improvement from 30 percent to 35 percent in "highly satisfied" ratings from Enterprise customers.		1R12: Customer Feedback: Continue the solicitation of customer feedback on the services, facilities, and expertise provided by the Aerospace Technology Enterprise.	2R11: Continue the solicitation of customer feedback on the services, facilities, and expertise provided by the Aerospace Technology Enterprise.
Assessment	Green		TBD	TBD
Annual Performance Goal and APG #	9R19: Transfer at least 10 new technologies and processes to industry during the fiscal year.	0R15: Transfer at least 12 new technologies and processes to industry during the fiscal year.		
Assessment	Blue	Blue		

Commercialization — Facilitate the greatest practical utilization of NASA know-how and physical assets by U.S. industry.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	9R21: For all new program activities initiated in FY 99, develop an education outreach plan, which includes and results in an educational product. This product shall be consistent with current educational standards and use program content to demonstrate or enhance the learning objectives.	0R16: Continue the implementation of current education outreach plans and establish new plans for all new program activities initiated in FY 00.	1R13: Education Outreach: Continue the implementation of current education outreach plans, and establish new plans for all new program activities initiated in FY 2001.	2R12: Continue the implementation of current education outreach plans, and establish new plans for all new program activities initiated in FY 2002.
Assessment	Yellow	Blue	TBD	TBD
Annual Performance Goal and APG #	9R20: Establish an Aeronautics Education Laboratory in at least three new sites in the United States.			
Assessment	Blue			

Utilize NASA's Space Transportation Council (STC) in combination with an External Independent Review Team (EIRT) to assure agency-level integration of near and far-term space transportation investments.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #				2R13: Review results of NASA and commercial-sector performed launch system architecture studies, related requirements, and refinements in planned risk-reduction investments.
Assessment				TBD

Aerospace Technology Enterprise FY 2002		AEROSPACE FOCUSED						AEROSPACE BASE R&T					
	Budget Category	Aviation System Capacity	Aviation Safety Technology	Ultra-Efficient Engine Technology	Small Aircraft Transportation System	Quiet Aircraft Technology	2nd Generation RLV	Aero-Space Base R&T -- Computing, Information & Communication Technology	Aero-Space Base R&T -- Flight Research	Aero-Space Base R&T -- Propulsion & Power	Aero-Space Base R&T -- Vehicle System Technology	Aero-Space Base R&T -- Space Transfer & Launch Tech.	R&PM
Annual Performance Goal													
2R1: NASA's research stresses aviation system monitoring and modeling, accident prevention, and accident mitigation. The annual performance goal is to complete the interim progress assessment utilizing the technology products of the Aviation Safety program as well as the related Aerospace Base R&T efforts and transfer to industry an icing CD-ROM, conduct at least one demonstration of an aviation safety related subsystem, and develop at least two-thirds of the planned models and simulations.			X					X		X	X		X
2R2: NASA's research stresses engine technology to reduce the emissions of oxides of nitrogen (NOx) and carbon dioxide (CO2). The annual performance goal is to complete sector testing of a low-NOx combustor concept capable of a 70% reduction in NOx from the 1996 International Civil Aviation Organization (ICAO) baseline, and demonstrate at least one additional concept for the reduction of other emittants.				X						X	X		X

Aerospace Technology Enterprise FY 2002		AEROSPACE FOCUSED						AEROSPACE BASE R&T					
	Budget Category	Aviation System Capacity	Aviation Safety Technology	Ultra-Efficient Engine Technology	Small Aircraft Transportation System	Quiet Aircraft Technology	2nd Generation RLV	Aero-Space Base R&T -- Computing, Information & Communication Technology	Aero-Space Base R&T -- Flight Research	Aero-Space Base R&T -- Propulsion & Power	Aero-Space Base R&T -- Vehicle System Technology	Aero-Space Base R&T -- Space Transfer & Launch Tech.	R&PM
Annual Performance Goal													
2R3: NASA's research stresses reducing noise in the areas of engines, nacelles, engine-airframe integration, aircraft interiors and flight procedures. The annual performance goal is to assess and establish the strongest candidate technologies to meet the 10- decibel reduction in community noise.						X				X	X		X
2R4: NASA's research stresses operations systems for safe, efficient air traffic management and new aircraft configurations for high productivity utilization of existing runways. The annual performance goal is to develop a decision support tool, and define concepts for future for future aviation system concepts.		X						X			X		X

Aerospace Technology Enterprise FY 2002		AEROSPACE FOCUSED						AEROSPACE BASE R&T					
	Budget Category	Aviation System Capacity	Aviation Safety Technology	Ultra-Efficient Engine Technology	Small Aircraft Transportation System	Quiet Aircraft Technology	2nd Generation RLV	Aero-Space Base R&T -- Computing, Information & Communication Technology	Aero-Space Base R&T -- Flight Research	Aero-Space Base R&T -- Propulsion & Power	Aero-Space Base R&T -- Vehicle System Technology	Aero-Space Base R&T -- Space Transfer & Launch Tech.	R&PM
Annual Performance Goal													
2R5: NASA's research stresses aircraft technologies which enable the use of existing small community and neighborhood airports, without requiring control towers, radar installations, and more land use for added runway protection zones. The annual performance goal is to baseline in partnership with the FAA the system engineering documents for the Small Aircraft Transportation System concept.					X						X		X
2R6: NASA's investments emphasize thorough mission needs development, requirements definition, and risk reduction effort leading to commercially owned and operated launch systems to meet NASA needs with commercial application where possible. The annual performance goal is to complete risk reduction and architecture reviews to support design and demonstration decisions.							X	X				X	X

Aerospace Technology Enterprise FY 2002		AEROSPACE FOCUSED						AEROSPACE BASE R&T					
	Budget Category	Aviation System Capacity	Aviation Safety Technology	Ultra-Efficient Engine Technology	Small Aircraft Transportation System	Quiet Aircraft Technology	2nd Generation RLV	Aero-Space Base R&T -- Computing, Information & Communication Technology	Aero-Space Base R&T -- Flight Research	Aero-Space Base R&T -- Propulsion & Power	Aero-Space Base R&T -- Vehicle System Technology	Aero-Space Base R&T -- Space Transfer & Launch Tech.	R&PM
Annual Performance Goal													
2R7: NASA's investments emphasize thorough mission needs development, requirements definition, and risk reduction effort leading to commercially owned and operated launch systems to meet NASA needs with commercial application where possible. The annual performance goal is to complete risk reduction and architecture reviews and initial hardware demonstrations to support design and demonstration decisions.							X	X		X	X	X	X
2R8: NASA's long term research emphasizes innovative propulsion systems. The performance target is to conduct a test of an advanced ion propulsion engine.										X		X	
2R9: NASA's investments emphasize advances in experimental vehicles, flight testbeds, and computing tools to enable revolutionary designs. The annual performance goal is to conduct at least five demonstrations of revolutionary aerospace subsystems.								X	X	X	X	X	X

Aerospace Technology Enterprise FY 2002		AEROSPACE FOCUSED						AEROSPACE BASE R&T					
	Budget Category	Aviation System Capacity	Aviation Safety Technology	Ultra-Efficient Engine Technology	Small Aircraft Transportation System	Quiet Aircraft Technology	2nd Generation RLV	Aero-Space Base R&T -- Computing, Information & Communication Technology	Aero-Space Base R&T -- Flight Research	Aero-Space Base R&T -- Propulsion & Power	Aero-Space Base R&T -- Vehicle System Technology	Aero-Space Base R&T -- Space Transfer & Launch Tech.	R&PM
Annual Performance Goal													
2R10: NASA's investments emphasize revolutionary technologies such as nanotechnology, information technology and biotechnology which could enable new missions and capabilities. The annual performance goal is to develop at least two new materials concepts and demonstrate the feasibility of at least two nanotechnology and two other concepts.								X		X	X	X	X
2R11: Continue the solicitation of customer feedback on the services, facilities, and expertise provided by the Aerospace Technology Enterprise.													X
2R12: Continue the implementation of current education outreach plans, and establish new plans for all new program activities initiated in FY 2002.													X
2R13: Review results of NASA and commercial-sector performed launch system architecture studies, related requirements, and refinements in planned risk-reduction investments.							X						X

Biological and Physical Research Enterprise (BPRE)

Mission

NASA's Office of Biological and Physical Research (OBPR) conducts interdisciplinary fundamental and applied research to pursue answers to the basic questions underlying human space flight:

- How can human existence expand beyond the home planet to achieve maximum benefits from space?
- How do fundamental laws of nature shape the evolution of life?

The microgravity environment of space allows scientists to open a new window on the most basic and important biological, chemical, and physical processes. At the same time, the space environment poses major challenges to the well-being of space travelers. Space flight exposes humans to low gravity and radiation environments never before encountered in our evolutionary history. As we seek to exploit the rich opportunities of space flight for fundamental research and commercial development, we must develop efficient and effective technologies and methods for protecting human health in space.

Goal 1: Conduct research to enable safe and productive human habitation of space.

OBPR conducts fundamental and applied research in the biological and physical sciences to reduce the health risks of space travel. We conduct research on technology for efficient, self-sustaining life-support systems to provide safe, hospitable environments for space exploration, and develop advanced technologies for healthcare delivery. Advances in healthcare first developed for the space flight environment are applied on Earth to enhance healthcare.

Goal 2: Use the space environment as a laboratory to test the fundamental principles of physics, chemistry, and biology.

The space environment offers a unique laboratory in which to study biological and physical processes. Researchers take advantage of this environment to conduct experiments that are impossible on Earth. For example, most combustion processes on Earth are dominated by the fact that hot gases rise. In space, this is not the case, and hidden properties of combustion emerge. Materials scientists study the role of gravity in important industrial processes. Physicists take advantage of microgravity to study exotic forms of matter that are better handled in space. Biological researchers investigate the role of gravity in life processes and how the space environment affects living organisms. The knowledge derived from OBPR's diverse research will inform and expand scientific understanding, support economic and technological progress, and help to enable human exploration of space.

Goal 3: Enable and promote commercial research in space.

OBPR provides knowledge, policies, and technical support to facilitate industry investment in space research. OBPR will continue to enable commercial researchers to take advantage of space flight opportunities for proprietary research. The commercial sector

will grow to become the premier mechanism for applying space knowledge to benefit the American people. Commercial applications of space knowledge will generate new products, new jobs, and new spin-off companies.

Goal 4: Use space research opportunities to improve academic achievement and the quality of life.

OBPR seeks to use its research activities to encourage educational excellence and to improve scientific literacy from primary school through the university level and beyond. We deliver value to the American people by facilitating access to the experience and excitement of space research. OBPR strives to involve society as a whole in the transformations that will be brought about by research in space.

Resource Requirements

(NOA, dollars in millions)

	FY1999	FY 2000	FY 2001	FY 2002
$M			313	820
CS FTE			427	1242

With the formation of a new Biological and Physical Research Enterprise, resource requirements for annual performance goals are somewhat more transparent. Each annual performance goal is associated with a specific program budget; however, the majority of OBPR performance goals are overarching and interdependent in nature. They are not budgeted as discrete elements of OBPR programs.

Implementation Strategy

OBPR's program is implemented at seven NASA Field Centers and the Jet Propulsion Laboratory, as well as through the participation of Commercial Space Centers (CSCs), a National Space Biomedical Research Institute, and a National Center for Microgravity Research on Fluids and Combustion. OBPR relies upon an extensive external community of academic, commercial and government scientists and engineers for the implementation of its programs. OBPR-supported science and technology research projects are reviewed by scientific or technical peers. In selecting investigations and projects to support—and ultimately for access to space—OBPR follows peer-review processes appropriately designed for scientific research, technology research and development, and commercial research. Our peer review processes ensure the competitiveness and quality of OBPR research.

OBPR implements its research programs through ground-based as well as flight research. Ground-based research precedes flight research and employs NASA facilities such as drop towers, centrifuges, and bed-rest facilities. The flight research programs use the full spectrum of platforms, including free-flying satellites, Space Shuttle, and now ISS.

Roadmap: [Source: NASA Strategic Plan]

Near–term Plans (2000-2005)	Mid-term Plans (2006-2011)	Long-term Plans (2012-2025)
• Identify mechanisms of health risk and potential physiological and psychological problems to humans living and working in space, and begin developing and testing countermeasures. • Conduct scientific and engineering research and enable commercial research activities on the ISS to enrich health, safety, and the quality of life on Earth. • Begin developing interdisciplinary knowledge (e.g., biology, physics, materials) to support safe, effective, and affordable human/robotic exploration.	• Understand the effects of long-duration space flight (e.g., radiation), validate countermeasures and technology and begin developing countermeasures for long-duration space flight. • Extend our understanding of chemical, biological, and physical systems. • Test and validate technologies that can reduce the overall mass of human support systems by a factor of three (compared to 1990's levels).	• Apply and refine countermeasures for safe, effective, and affordable long-duration human space flight. • Achieve a deep understanding of the role of gravity in complex chemical, biological, and physical processes. • Test and validate technologies for safe, self-sufficient, and self-sustaining life support systems that can enable humans to live and work in space and on other planets for extended periods.

OBPR is preparing for the transition to a new era in human space flight. The International Space Station (ISS) will provide a growing capability as a research platform. OBPR will work to extract the maximum scientific and commercial return from this promising research facility while conducting research to ensure the health and safety of space travelers in the near term and into the future.

Performance Measures

OBPR will conduct interim evaluations and monitoring of performance targets at midyear and at the end of the fiscal year. OBPR will present progress on each annual performance goal to its NASA Advisory Committee subcommittee, the Biological and Physical Research Advisory Committee. This committee will evaluate progress toward each annual performance goal and assign a qualitative score of red, yellow, green, or blue, with blue indicating outstanding progress, green indicating satisfactory progress, yellow indicating poor or partially satisfactory progress, and red indicating unsatisfactory progress.

Goal: Conduct research to enable safe and productive human habitation of space.

Objective: Conduct research to ensure the health, safety, and performance of humans living and working in space.

Millions of years of evolution have molded the human body to cope with and rely upon gravity. Virtually every system of the body responds when a person travels to space. Weight-bearing bones lose about 1% of bone mass per month. Muscles atrophy, and nerves in the balance system begin to rewire their connections to take account of the sudden disappearance of up and down. Many of these changes pose significant health issues, especially when space travelers return to gravity. NASA research will identify methods that will efficiently control the effects of space travel and ensure the health and safety of future space travelers.

Public Benefit: The primary goal of this research is to improve health and safety for space travelers; however, this research also has the potential to make significant contributions to medical care on Earth. For example, space flight can provide models for exploring osteoporosis and other diseases of muscle and bone. It has provided unique insights into nerve regeneration and the capacity of the nervous system to grow, change, and adapt in response to environmental stimuli. The parallels between aging and space travel are currently under study by researchers at NASA and the National Institutes of Aging. OBPR has used the Critical Path Roadmap to link indicators under this Performance Goal to the Agency's longer-term objectives in this area of research.

Annual Performance Goal 2B1: Earn external review rating of “green” or “blue” by making progress in the following research focus areas as described in the associated indicators:

- Identify and test biomedical countermeasures that will make space flight safer for humans.
- Identify and test technologies that will enhance human performance in space flight.

Performance Indicators:

- Complete protocols for flight testing countermeasure to reduce kidney stone risk.
- Develop an investigation of crew nutritional needs and metabolism status.
- Prepare in-flight validation of cardiovascular countermeasures.
- Evaluate and provide annual report of the progress in reducing medical risk factors.

Public Benefit: Humans can only travel to space by bringing a microcosm of the Earth with us. We need an atmosphere, food, water, and protection from temperature extremes and space radiation. NASA research will develop advanced technologies for efficient life support systems to provide these needs with minimal resupply from Earth. These technologies will reduce the cost of space travel and may find application in process control systems for industry, and even in helping to provide clean environments in homes, vehicles, and offices.

Annual Performance Goal 2B2: Earn external review rating of "green" or "blue" by making progress in the following research focus area:

- Identify and test new technologies to improve life support systems for spacecraft.

Performance Indicators:

- OBPR will demonstrate, through vigorous research and technology development, a 33% reduction in the projected mass of a life support flight system compared to the current (FY 2001) system baselined for ISS. The quantitative calculation of this metric will be posted on the Internet.
- Complete a radiation protection plan that will guide future research and development to improve health and safety for space travelers.

Objective: Conduct research on biological and physical processes to enable future missions of exploration.

Basic research in the biological and physical sciences is an essential precursor to future advanced technologies and systems for supporting a human presence in space. Beyond reducing the cost and increasing safety for space travelers, this basic research promises to push the frontiers of knowledge and technology for Earth applications.

Public Benefit: Our collaborative effort with the National Cancer Institute will support the future development of next-generation instruments for molecular-level diagnostics for space and Earth application. Basic insights into biological and physical mechanisms behind physiological changes in space will support the future of human presence in space while adding to the store of biomedical knowledge that underlies medical care on Earth.

Annual Performance Goal 2B3: Earn external review rating of "green" or "blue" by making progress in the following research focus areas:

- Develop and test cutting-edge methods and instruments to support molecular-level diagnostics for physiological and chemical process monitoring.
- Identify and study changes in biological and physical mechanisms that might be exploited for ultimate application to improving the health and safety of space travelers.

Performance Indicators:

- Collaborate with the National Cancer Institute to create and maintain a core program using academic, industrial, and government researchers to develop and test cutting-edge methods and instruments to support molecular-level diagnostics for physiological and chemical processes.
- Develop a study on the effects of space flight on bone loss as a function of age in an animal model.
- Develop studies on space-flight-induced genomics changes.

Goal: Use the space environment as a laboratory to test the fundamental principles of physics, chemistry, and biology.

Objective: Investigate chemical, biological, and physical processes in the space environment, in partnership with the scientific community.

Gravity's influence is everywhere. From the structure that gives steel its strength, to the structure of bone in a growing child, gravity plays a role. Researchers can only eliminate the effects of gravity in space. In space, we can study how gravity has shaped life on Earth and how living things respond to its absence. In space, we enter a new realm of research in physics, chemistry, and biology. NASA conducts research in focused areas with the potential to improve life on Earth. We rely on the advice of the Space Studies Board of the National Research Council, as well as the NASA Advisory Committees and associated cross-disciplinary task groups to set the strategic direction of the program.

Public Benefit: Research on complex physical and biological systems has the potential to benefit industrial applications in optical computing and communications, pharmaceutical packaging, food manufacturing, cosmetics, and polymer manufacturing.

Annual Performance Goal 2B4: Earn external review rating of "green" or "blue" by making progress in the following research focus areas as described in the associated indicators:

- Advance the scientific understanding of complex biological and physical systems.

Performance Indicators:

- Prepare an ISS research investigation on colloidal physics.
- Maintain a peer-reviewed research program in Complex Systems physics and chemistry.

Public Benefit: This biotechnology research may have applications in structural biology, rational drug design, and artificial tissues engineering for medical applications.

Annual Performance Goal 2B5: Earn external review rating of "green" or "blue" by making progress in the following research focus areas as described in the associated indicators:

- Elucidate the detailed physical and chemical processes associated with macromolecular crystal growth and cellular assembling processes in tissue cultures.

Performance Indicators:

- Maintain a peer-reviewed research program in macromolecular and cellular biotechnology.
- Prepare ISS research investigations in protein crystallization and three-dimensional tissue culture.

Public Benefit: Space flight provides a unique environment for fundamental research in fluid physics and materials science which supports human space flight and produces valuable insights into industrial processes on Earth. Integrating fluid physics and materials science with fundamental biology provides unique new research capabilities that will be implemented by an interdisciplinary program with access to space.

Annual Performance Goal 2B6: Earn external review rating of "green" or "blue" by making progress in the following research focus areas as described in the associated indicators:

- Initiate a focused research program specifically integrating fluid physics and materials science with fundamental biology.

Performance Indicators:

- Initiate the definition of a Bio-science and Engineering institute to drive novel concepts for space-based investigations in biomolecular systems.

Public Benefit: This basic research has the potential to substantially enhance the accuracy of our time-keeping standard, support development of ultra-precise Global Positioning System time measurements, and support the development of molecular-based medical diagnostic devices.

Annual Performance Goal 2B7: Earn external review rating of "green" or "blue" by making progress in the following research focus area:

- Investigate fundamental and unresolved issues in condensed matter physics and atomic physics, and carry out atomic clock development for space-based utilization.

Performance Indicators:

- Maintain an outstanding and peer-reviewed research program in condensed matter physics, Bose-Einstein Condensation, and atomic clocks development for space-based utilization.
- Produce scientific discoveries in atomic and condensed matter physics, and publish in mainstream peer-reviewed archival journals.
- Design and develop flight experiment apparatus for low-temperature physics, laser cooling, and atomic physics investigations on the ISS.

Public Benefit: This research has the potential to support advances in energy production efficiency, combustion products emission control, advanced materials manufacturing, and the chemical engineering industry.

Annual Performance Goal 2B8: Earn external review rating of "green" or "blue" by making progress in the following research focus area:

- Investigate fundamental and unresolved issues in fluid physics, and materials and combustion science using gravity as a theoretical and experimental revealing tool.

Performance Indicators:
- Maintain an outstanding and peer-reviewed program in fluid physics, and materials and combustion sciences.
- Complete the preparation for ISS investigations in fundamental materials science to be carried out in the Microgravity Science Glovebox.
- Prepare two major space-based combustion research experiments for flight on the Space Shuttle.
- Initiate a new annual process to solicit and select peer-reviewed, ground-based investigations in materials science, fluid physics, and combustion research.

Public Benefit: This basic research has the potential to support improved medical care and agricultural performance by strengthening our basic understanding of biological processes.

Annual Performance Goal 2B9: Earn external review rating of "green" or "blue" by making progress in the following research focus area:
- Understand the role of gravity in biological processes at all levels of biological complexity.

Performance Indicators:
- Maintain an outstanding and peer-reviewed program in fundamental space biology.
- Develop and implement Fundamental Space Biology research plans to utilize early ISS capability.
- Determine baseline data requirements for model specimens to be used on ISS.
- Plan for incorporation of baseline data collection in ISS hardware validation flights.

Objective: Develop strategies to maximize scientific research output on the International Space Station and other space research platforms.

Space flight opportunities for biological and physical research are very scarce. OBPR develops strategies and approaches to enhance flight opportunities and to support a balanced research program so as to maximize scientific return.

Public Benefit: By working with the scientific community, OBPR seeks to maximize scientific return from space flight opportunities.

Annual Performance Goal 2B10: In close coordination with the research community, allocate flight resources to achieve a balanced and productive research program.

Performance Indicators:
- Assume management responsibility for the ISS research budget.
- Begin procurement activities leading to a Non-Governmental Organization for Space Station Research.
- Coordinate scientific community participation in the definition of ISS research.
- Balance resource allocations and flight opportunities through a Partner Utilization Plan.
- Prepare peer-reviewed and commercial research investigations for execution on STS-107.

- Conduct early research on the International Space Station.

Public Benefit: Improving life on Earth. Successfully implementing this annual performance goal brings the many benefits of space research directly to the public through new discoveries and improved technology applications in areas such as medicine, industrial processes and fundamental knowledge for that year

Annual Performance Goal 2H13: Demonstrate progress toward ISS research hardware development.

Indicators:
- Complete development of 3 U.S provided research racks for ISS
- Provide integration support for delivery of 2 International Partner provided research racks for ISS

Goal: Enable and promote commercial research in space.

Objective: Provide technical support for companies to begin space research.
Objective: Foster commercial research endeavors with the International Space Station and other assets.

Ultimately, the solutions to the challenges of human space flight will open up new avenues of commerce. Even now, dozens of commercial firms conduct small-scale research projects in space. OBPR provides knowledge, policies, and technical support to facilitate industry investment in space research. OBPR will continue to enable commercial researchers to take advantage of space flight opportunities for proprietary research. The commercial sector will grow to become the premier mechanism for applying space knowledge to benefit the American people. Commercial applications of space knowledge will generate new products, new jobs, and new spin-off companies.

Public Benefit: The benefits of commercial research in space include improved products and services to enhance economic performance on Earth. In the long-term, economic activity in space will provide strengthened infrastructure for the exploration and development of space.

Annual Performance Goal 2B11: Engage the commercial community and encourage non-NASA investment in commercial space research by meeting at least three of four performance indicators.

Performance Indicators:
- Maintain or increase non-NASA investment in commercial space research during the FY 2002 transition from a Shuttle-based to an ISS-based program.
- Maintain a ratio of non-NASA funding to NASA funding of not less than 3:1 in FY 2002.

- Ensure that one of the 39 product lines currently under investigation is brought to market, available for commercial purchase, in FY 2002.
- Enable at least 10 new, active industrial partnerships to be established with the Space Product Development Commercial Space Centers.

Objective: Systematically provide basic research knowledge to industry.

Public Benefit: Conducting outreach to the commercial community extends the benefits of commercial research to the broadest set of participants and strengthens the contributions of commercial research for the development of space.

Annual Performance Goal 2B12: Highlight ISS-based commercial space research at business meetings and conferences.

Performance Indicators:
- Support at least 3 business/trade conferences to highlight ISS-based commercial space research.

Goal: Use space research opportunities to improve academic achievement and the quality of life.

Objective: Advance the scientific, technological, and academic achievement of the Nation by sharing our knowledge, capabilities, and assets.

Public Benefit: OBPR seeks to use its research activities to encourage educational excellence and to improve scientific literacy from primary school through the university level and beyond.

Annual Performance Goal 2B13: Provide information and educational materials to American teachers.

Performance Indicators:
- Develop electronic and printed educational materials which focus on biological and physical research, and distribute these materials at at least three conferences and through the Internet.

Objective: Engage and involve the public in research in space.

Public Benefit: OBPR delivers value to the American people by facilitating access to the experience and excitement of space research. OBPR strives to involve society as a whole in the transformations that will be brought about by research in space.

Annual Performance Goal 2B14: Work with media outlets and public institutions to disseminate OBPR information to wide audiences.

Performance Indicators:
- Work with PBS and Discovery Channel producers to explore opportunities for TV products with

space/research/microgravity themes.

- Work with Life Science Museum Network members to explore opportunities for the development of projects, special events, or workshops focused on Life Sciences biology-related research themes to attract and engage public audiences.
- Make available to wide audiences an online database of Commercial Space Center activities, including publications listings, patents, and other information useful to the public.

Verification/Validation

OBPR cooperates with NASA's Inspector General during an annual review of the accuracy of our reporting process. The Life and Microgravity Sciences and Applications Advisory Subcommittee is not expected to independently confirm the accuracy of data presented by OBPR. Rather, the Committee's role is to assess progress based on the data that OBPR presents and apply its expert judgement to produce an evaluation. The Office of the Inspector General selects a subset of targets for detailed audits to determine the accuracy and reliability of OBPR's data on performance targets.

Annual performance goals 2B1 through 2B9 are fundamentally qualitative in nature and the committee will have broad discretion in assigning scores on these goals based on performance indicators as well as other information. Annual performance goal 2B2 is evaluated using a novel formula developed by OBPR's Advanced Human Support Technology program. Details of this process are available for review on the program's website at http://ADVLIFESUPPORT.JSC.NASA.GOV/ under the title "Advanced Life Support Metric Document".

Annual Performance Goals 2B10 through 2B14 are more readily evaluated using objective criteria as established in their associated indicators.

MULTI-YEAR PERFORMANCE TREND
Biological and Physical Research Enterprise (BPRE)

Objective: Conduct research to ensure the health, safety, and performance of humans living and working in space.

	FY 1999	**FY 2000**	**FY 2001**	**FY 2002**
APG	H29: Perform component and subsystem ground tests without humans in the loop to demonstrate advanced technologies, including biological water processor, and flight test a new electronic "nose" sensor on a chip.	0H31: Complete the first phase (including outfitting three test chambers) of the Advanced Life Support System Integration Test Bed facility that will provide the capability to conduct a series of long duration, human-in-the-loop, advanced technology tests over the next six years. Demonstrate key technology capabilities for human support, such as advanced techniques for water processing using microbes, waste processing using biological degradation and fluidized bed incineration, a no-expendable trace gas contaminant control system, solid waste processing, and flight test of a miniature mass spectrometer.	1H18 Demonstrate, in ground test, at least one technology that could reduce up to 25% of life support logistics over ISS baseline and release report of progress for review on the Internet.	2B2 Earn external review rating of "green" or "blue" by making progress in the following research focus area: • Identify and test new technologies to improve life support systems for spacecraft.
Assessment	Green	Green	TBD	TBD

Objective: Conduct research to ensure the health, safety, and performance of humans living and working in space.

	FY 1999	FY 2000	FY 2001	FY 2002
APG	H25 Complete the development of countermeasure research protocols, and begin testing a minimum of three countermeasures intended to protect bone, muscle, and physical work capacity. H6 Publish a report defining the time course adaptations in the balance system to altered gravitational environments. H10 Document Mir radiation research data to facilitate ISS EVA planning. H7 Document Mir data lessons learned to facilitate ISS biomedical and countermeasure research.	0H26 Develop medical protocols and test the capability of the Crew Health Care System as integrated in the ISS U.S. Laboratory. 0H25 Evaluate and develop for flight testing a minimum of three major research protocols intended to protect bone, muscle, and physical work capacity and prepare a minimum of 10 biomedical research experiments, (utilizing the capabilities of the STS and ISS HRF) to study human responses to the gravitational environment.	1H17 Develop new biomedical and technological capabilities to facilitate living and working in space and safe return to Earth. 1H31 Initiate implementation of the Bioastronautics Initiative by beginning a NASA /NCI collaboration and conducting a peer review of NSBRI to assess expansion.	2B1 Earn external review rating of "green" or "blue" by making progress in the following research focus areas as described in the associated indicators: • Identify and test biomedical countermeasures that will make space flight safer for humans. • Identify and test technologies that will enhance human performance in space flight.
Assessment	Green	Green	TBD	TBD

Objective: Conduct research on biological and physical processes to enable future missions of exploration..

	FY 1999	FY 2000	FY 2001	FY 2002
APG	H5 Publish a report of comparison of 3 different biological models to understand the influence of gravity on the nervous system. H8 Document Mir data lessons learned to facilitate ISS research in fundamental biology and regenerative life support.	0H33 Complete Radiation Research Instrument for Mars 2001 mission to study transit, orbital, and surface radiation effects and conduct three workshops to define and prioritize research tasks in subjects such as radiation shielding materials, in situ resource utilization, and fluids management and heat transfer technology. Complete the science definition of granular flows, flight, and dust management experiments to begin gathering research data to alleviate critical problems of dust buildup, habitat foundation engineering, and rover performance during planetary exploration.	1H31 Initiate implementation of the Bioastronautics Initiative by beginning a NASA /NCI collaboration and conducting a peer review of NSBRI to assess expansion.	2B3 Earn external review rating of "green" or "blue" by making progress in the following research focus areas: • Develop and test cutting-edge methods and instruments to support molecular-level diagnostics for physiological and chemical process monitoring. • Identify and study changes in biological and physical mechanisms that might be exploited for ultimate application to improving the health and safety of space travelers.
Assessment	Green	Green	TBD	TBD
APG	H26 Initiate a collaborative program to design and develop instruments		1H1 Complete testing and delivery for spacecraft integration of experiments for the Mars Surveyor Program 2001 missions.	
Assessment	Green		TBD	

Objective: Investigate chemical, biological, and physical processes in the space environment, in partnership with the scientific community.

	FY 1999	FY 2000	FY 2001	FY 2002
APG				2B4 Earn external review rating of "green" or "blue" by making progress in the following research focus areas as described in the associated indicators: • Advance the scientific understanding of complex biological and physical systems.
Assessment				TBD
APG	H9 Analyze Mir data to achieve a 3-year jump-start for cell culture and protein crystal growth research and document analyses & lessons learned.			2B5 Earn external review rating of "green" or "blue" by making progress in the following research focus areas as described in the associated indicators: • Elucidate the detailed physical and chemical processes associated with macromolecular crystal growth and cellular assembling processes in tissue cultures.
Assessment	Green			TBD

Objective: Investigate chemical, biological, and physical processes in the space environment, in partnership with the scientific community.

	FY 1999	FY 2000	FY 2001	FY 2002
APG				2B6 Earn external review rating of "green" or "blue" by making progress in the following research focus areas as described in the associated indicators: • Initiate a focused research program specifically integrating fluid physics and materials science with fundamental biology.
Assessment				TBD
APG				2B7 Earn external review rating of "green" or "blue" by making progress in the following research focus area: • Investigate fundamental and unresolved issues in condensed matter physics and atomic physics, and carry out atomic clock development for space-based utilization.
Assessment				TBD

Objective: Investigate chemical, biological, and physical processes in the space environment, in partnership with the scientific community.

	FY 1999	FY 2000	FY 2001	FY 2002
APG	H13 Use data obtained by fluid physics experiments on suspensions of colloidal particles on MSL-1 to answer fundamental questions in condensed matter physics regarding the transition between liquid and solid phases and publish data on the transition from liquids to solids and the results in peer-reviewed open literature. H11 Improve predictive capabilities of soot processes by at least 50% through analysis of MSL-1 data; publish results in peer-reviewed open literature. H12 Use MSL-1 results to eliminate one of the three primary fluid flow regimes from consideration by casting engineers, and publish this result in peer reviewed literature. Casting engineers may use this information to improve metal casting processes in industry.	0H11 Using suborbital rockets, complete one combustion experiment on the flame spread of liquid fuels to better control Earth/space-based fire hazards, and conduct one investigation to test theories of fundamental physics properties and physical laws of fluids to provide key data for earth and space-based processing materials; report the results.		2B8 Earn external review rating of "green" or "blue" by making progress in the following research focus area: • Investigate fundamental and unresolved issues in fluid physics, and materials and combustion sciences using gravity as a theoretical and experimental revealing tool.
Assessment	Green	Red		TBD

Objective: Investigate chemical, biological, and physical processes in the space environment, in partnership with the scientific community.

	FY 1999	FY 2000	FY 2001	FY 2002
APG				2B9 Earn external review rating of "green" or "blue" by making progress in the following research focus area: • Understand the role of gravity in biological processes at all levels of biological complexity.
Assessment				TBD

Objective: Develop strategies to maximize scientific research output on the International Space Station and other space research platforms.

APG				2B10 In close coordination with the research community, allocate flight resources to achieve a balanced and productive research program.
Assessment				TBD
APG		0H26 Develop medical protocols and test the capability of the Crew Health Care System as integrated in the ISS U.S. Laboratory.	1H5 Continue initial research on the International Space Station by conducting 6 to 10 investigations.	2H13 Demonstrate progress toward ISS research hardware development.
Assessment		Green	TBD	

Objective: Develop strategies to maximize scientific research output on the International Space Station and other space research platforms.

	FY 1999	FY 2000	FY 2001	FY 2002
APG		0H9 Complete data reduction from the STS-95 Research Module mission. Begin to explore new cooperative efforts with NIH in the area of aging and transfer space-derived research for industry development of a new drug to treat Chagas' disease.	1H4 Conduct outstanding peer-reviewed and commercial research on STS-107 to advance knowledge in the fields of medicine, fundamental biology, biotechnology, fluid physics, materials processing and combustion	
Assessment		Green	TBD	
APG	H1 Support an expanded research program of approximately 800 investigations, an increase of ~9% over FY 1998. H2 Publish 90% of FY 1998 science research progress in the annual OLMSA Life Sciences and Microgravity Research Program Task Bibliographies and make it available on the Internet. H3 Establish a National Center for Evolutionary Biology with participation of at least 5 research institutions and engaging at least 20 investigators.	0H1 Support an expanded research program of approximately 935 investigations, an increase of ~17% over FY 1999. Publish 100 percent of science research progress in the annual OLMSA Life Sciences and Microgravity Research Program Task Bibliographies and make this available on the Internet.	1H3 Support an expanded, productive research community to include 975 investigations annually by 2001.	
Assessment	Green	Green	TBD	

Objective: Foster commercial research endeavors with the International Space Station and other assets.
Objective: Provide technical support for companies to begin space research.

	FY 1999	FY 2000	FY 2001	FY 2002
APG	H35 Increase non-NASA investment (cash and in-kind) in space research from $35M in FY96 to at least $50M in FY 1999, a 40% increase. H30 Complete the development of a commercialization plan for the ISS and Space Shuttle in partnership with the research and commercial investment communities and define and recommend policy and legislative changes. H36 Establish a new food technology Commercial Space Center.	0H47 Establish up to 2 new Commercial Space Centers. 0H49 Foster the establishment of a telemedicine hub in Western Europe. NASA and CNES will develop an international telemedicine program to incorporate and connect existing medical informatics capabilities into a user-friendly commercial electronic telemedicine hub and apply lessons learned to human space flight. 0H46 Utilize at least 30% of Space Shuttle and ISS FY 2000 capabilities for commercial investigations, per the U.S. Partner Utilization Plan.	1H23 Foster commercial endeavors by reviewing and/or implementing new policies and plans such as the Space Station resource pricing policy and intellectual property rights policy. Ensure that Space Station resources allocated to commercial research are utilized by commercial partners to develop commercial products and improve industrial processes. 1H22 Establish at least ten new, active industrial partnerships to research tomorrow's space products and improve industrial processes through NASA's Commercial Space Centers, and find opportunities for space experiments.	2B11 Engage the commercial community and encourage non-NASA investment in commercial space research by meeting at least three of four performance indicators.
Assessment	Green (H35, H36); Yellow (H30)	Green	TBD	TBD

Objective: Systematically provide basic research knowledge to industry.

APG				2B12 Highlight ISS-based commercial space research at business meetings and conferences.
Assessment				TBD

Objective: Advance the scientific, technological, and academic achievement of the Nation by sharing our knowledge, capabilities, and assets.

	FY 1999	FY 2000	FY 2001	FY 2002
APG	H37 Initiate a curriculum development program, in partnership with the International Technology Education Association (ITEA), for gravity related educational modules for national distribution which meet the current National Science Teachers Association (NSTA) National Standards for Science for Grades K-12, and the ITEA National Standards for Technology Education to be published June 1999. H39 Conduct at least two demonstrations of the applicability of the "Telemedicine Instrumentation Pack" for health care delivery to remote areas. H40 Demonstrate the application of laser light scattering technology for early detection of eye-tissue damage from Diabetes; publish results in peer-reviewed open literature.	0H56 The NASA-Sponsored National Space Biomedical Research Institute will conduct an open symposium relaying the results of space-oriented research activities focusing on up to 10 ground-related applications with the participation of interested investigators; publish results in a conference proceedings report.	1H26 Support participation in HEDS research.	2B13 Provide information and educational materials to American teachers.
Assessment	Green	Green	TBD	TBD

Objective: Engage and involve the public in research in space.

	FY 1999	FY 2000	FY 2001	FY 2002
APG	H38 Expand the microgravity research program's World Wide Web-based digital image archive established in 1998 by 50%.			2B14 Work with media outlets and public institutions to disseminate OBPR information to wide audiences.
Assessment	Green			TBD

Biological and Physical Research Enterprise FY 2002	Advanced Human Support Technology	Biomedical Research & Countermeasures	Fundamental Space Biology	Physical Sciences Research	Space Product Development	Mission Integration	Health Research	ISS Research
2B1: Earn external review rating of "green" or "blue" by making progress in the following research focus areas as described in the associated indicators: Identify and test biomedical countermeasures that will make space flight safer for humans. Identify and test technologies that will enhance human performance in space flight.		X						
2B2: Earn external review rating of "green" or "blue" by making progress in the following research focus area: Identify and test new technologies to improve life support systems for spacecraft.	X							
2B3: Earn external review rating of "green" or "blue" by making progress in the following research focus areas: Develop and test cutting-edge methods and instruments to support molecular-level diagnostics for physiological and chemical process monitoring. Identify and study changes in biological and physical mechanisms that might be exploited for ultimate application to improving the health and safety of space travelers.			X	X				
2B4: Earn external review rating of "green" or "blue" by making progress in the following research focus areas as described in the associated indicators: Advance the scientific understanding of complex biological and physical systems.				X				
2B5: Earn external review rating of "green" or "blue" by making progress in the following research focus areas as described in the associated indicators: Elucidate the detailed physical and chemical processes associated with macromolecular crystal growth and cellular assembling processes in tissue cultures.				X				
2B6: Earn external review rating of "green" or "blue" by making progress in the following research focus areas as described in the associated indicators: Initiate a focused research program specifically integrating fluid physics and materials science with fundamental biology.				X				

Biological and Physical Research Enterprise FY 2002	Advanced Human Support Technology	Biomedical Research & Countermeasures	Fundamental Space Biology	Physical Sciences Research	Space Product Development	Mission Integration	Health Research	ISS Research
2B7: Earn external review rating of "green" or "blue" by making progress in the following research focus area: Investigate fundamental and unresolved issues in condensed matter physics and atomic physics, and carry out atomic clock development for space-based utilization.				X				
2B8: Earn external review rating of "green" or "blue" by making progress in the following research focus area: Investigate fundamental and unresolved issues in fluid physics, and materials and combustion sciences using gravity as a theoretical and experimental revealing tool.				X				
2B9: Earn external review rating of "green" or "blue" by making progress in the following research focus area: Understand the role of gravity in biological processes at all levels of biological complexity.			X					
2B10: In close coordination with the research community, allocate flight resources to achieve a balanced and productive research program.	X	X	X	X	X	X		
2H13: Demonstrate progress toward ISS research hardware development.								X
2B11: Engage the commercial community and encourage non-NASA investment in commercial space research by meeting at least three of four performance indicators.					X			
2B12: Highlight ISS-based commercial space research at business meetings and conferences.					X			
2B13: Provide information and educational materials to American teachers.	X	X	X	X	X	X		
2B14: Work with media outlets and public institutions to disseminate OBPR information to wide audiences .	X	X	X	X	X	X		

Manage Strategically Crosscutting Process

Mission

Through NASA, the American people have invested in America's future by supporting an irreplaceable public aerospace research and development infrastructure consisting of a unique combination of physical resources and human talents. Managing these resources effectively and strategically is critical to achieving NASA's goals and objectives. Therefore, the goal of the Manage Strategically cross-cutting process is to provide a basis for the Agency to carry out its responsibilities effectively, efficiently, and safely through sound management decisions and practices. By integrating good general management practices with NASA's strategic processes, the Agency ensures that decisions are consistent with the goals, objectives, and strategies contained in NASA's Strategic, Implementation, and Performance Plans. Managing strategically also encourages all parts of the Agency to proceed together toward achieving a single set of strategic goals while enhancing management's ability to leverage limited resources, standardize processes where it makes sense to do so, streamline processes for timely results, and ensure rapid, reliable, open exchanges of information. Finally, managing strategically ensures that the public's investment in NASA is well-served and that the Agency's initiatives and achievements continuously inspire and serve America and benefit the quality of life on Earth for all humankind.

Implementation Strategy

For FY 2002, NASA's strategic management performance objectives (and associated annual performance goals) require the Agency to make the most effective use of appropriated funds, workforce, facilities, procurement processes and information technologies. In all cases, the performance metrics selected for FY 2002 reflect key management challenges particularly facing NASA. Additionally, several of the management areas, including management of human capital and financial management, address issues that have been identified by other organizations, including the General Accounting Office, as being Government-wide major management challenges. Finally, these management areas are also consistent with the Administration's reform agenda, which emphasize a Federal Government that is citizen-centered, results-oriented, and market-based.

Performance Metrics

Goal: Enable the Agency to carry out its responsibilities effectively, efficiently, and safely through sound management decisions and practices.

In order to know how successful we are in meeting the Manage Strategically goals and objectives, we have established nine annual performance goals, with accompanying indicators, against which we will measure our progress.

Objective: Protect the safety of our people and facilities and the health of our workforce.

Public Benefit: NASA protects the public's investment in our vision and missions by protecting the safety of the general public, the NASA astronauts and pilots, the NASA workforce, and our high-value equipment and property on and off the ground. The Agency's passion for and commitment to safety permeate everything we do, and all performance goals and indicators reflect NASA's priority-one commitment to health and safety, especially the goals and performance indicators in support of this managing strategically performance objective.

Annual Performance Goal: NASA will increase the safety of its infrastructure and the health of its workforce through facilities safety improvements, reduced environmental hazards, increased physical security, enhanced safety and health awareness, and appropriate tools and procedures for health enhancement. (2MS1)

- No fatalities will result from NASA mishaps.
- Per the Federal Worker 2000 Initiative, reduce the overall occurrence of injuries (due to occupational injury or illness) by 3% per year from the FY 1997 baseline to 1.15 occurrences per 100 workers.
- Award construction contract(s) for all identified critical facilities safety requirements as specified in the Agency Annual Construction Program.
- Award/modify all planned contracts for physical security upgrades to NASA's minimum essential infrastructure defined in the NASA Critical Infrastructure Plan.
- Reduce the level of Agency environmental noncompliance incidents and releases in order to achieve a 5% reduction from the FY 2000 level by 2005.
- Standardize and implement minimum elements of employee preventive and medical monitoring examinations to standardize services across the Agency using the recommendations from the U.S. Preventive Health Services Task Force.
- Establish a mechanism to aggregate employee epidemiological preventive health risk data for long-term tracking and as a basis for policy (This action will begin the process of creating an employee longitudinal health study similar to the Astronaut Longitudinal Health Study by establishing a voluntary, statistically significant pool of employees at each Center. This pool could potentially expand the control group for the Astronaut Study and will give NASA insight into any health hazards peculiar to each Center.).
- Develop and implement a medical quality assurance system based on comprehensive program audits of all aspects of health care delivery and assurances of professional competency.

This is NASA's first performance plan in which the inextricable relationship between safety and health has been clearly highlighted. The metrics contained under this annual performance goal focus on all components of ensuring a physically and psychologically safe and healthy work environment - by preventing worker and workplace mishaps.

Consistent with the Agency's Safety Initiative (ASI), launched in February 1999, NASA identified safety as its number one core value. ASI is aimed at strengthening NASA capabilities so that safety permeates every aspect of our work and that we routinely

incorporate safety and health principles and practices into daily decision making. As a key component of ASI, the Office of the Chief Health and Medical Officer, created in May 2000, provides strategic direction and oversight of all elements contributing to the achievement of a single goal – the protection of the health of the entire NASA workforce through optimal health care delivery and professional competency across the Agency. On the tactical level, this is accomplished by incorporating health and safety principles and practices into daily decision making at every level to ensure NASA adheres to the highest medical and ethical standards and satisfies all regulatory and statutory requirements.

Objective: Achieve the most productive application of Federal acquisition policies.

Public Benefit: NASA serves the public interest by implementing acquisition efficiencies and cost-saving strategies that provide the best return on the public's investment. These include streamlining acquisition regulations, assigning contractors more program-integration responsibility and accountability, and focusing NASA's civil service workforce on research and development activities rather than operational activities. In addition, NASA continuously seeks opportunities to partner with small, small disadvantaged, and women-owned businesses to increase the competitive base from which we purchase goods and services.

Annual Performance Goal: Continue to take advantage of opportunities for improved contract management by maintaining a high proportion of Performance Based Contracts (PBCs). (2MS2)

- Maintaining PBC obligations at greater than 80% of funds available for PBCs (funds available exclude grants, cooperative agreements, actions under $100,000, SBIR, STTR, FFRDCs, intra-governmental agreements, and contracts with foreign governments and organizations).

In order to utilize all categories of small business to the maximum extent practicable, at least meeting or exceeding the socioeconomic business goals set by Federal law or negotiated with the Small Business Administration, our annual performance goal will be:

Annual Performance Goal: Continue integrating small, small disadvantaged, and women-owned business together with minority universities into the competitive base from which NASA can purchase goods and services. (2MS9)

- Achieve at least an 8% Congressionally mandated goal for annual funding to small disadvantaged businesses (includes funding for prime and subcontractors awarded to programs supporting small disadvantaged businesses, Historically Black Colleges and Universities and other minority educational institutions, and women-owned small businesses).
- Award 1 percent of NASA's total contract and subcontract dollars to Historically Black Colleges and Universities and other minority institutions.

Addressing Procurement Management Challenges: NASA Office of Procurement has undertaken proactive management approaches in three key areas: human capital; outsourcing and oversight; and electronic commerce.

Human Capital: Over the last several years, procurement positions in the GS 1102 job series have been targeted areas for staff reductions. To help mitigate the impact of this decision on its customers and to ensure that the acquisition function remained viable at NASA, the Office of Procurement undertook several initiatives: 1) the NASA Career Development and Procurement Certification Programs, designed to ensure that acquisition professionals received uniform, high quality training that would meet or exceed statutory standards; 2) NASA's Contracting Intern Program, designed to ensure that an adequate number of well-trained, college-educated, entry level talent was available to the Agency to offset downsizing, retirements, and demographic trends (i.e., the aging of the work force); and 3) Rotational Assignments with Industry, designed to add a corporate experience dimension to the Office of Procurement's other developmental programs. The program seeks to equip already high performing, senior acquisition professionals with the tools necessary to help them assume future procurement management and other leadership. Collectively, the three programs address entry-level, mid-level, and senior-level staff developmental needs.

Outsourcing and Oversight: On November 2000, the Associate Administrator for Procurement and the Associate Administrator for Safety and Mission Assurance jointly announced the establishment of the Surveillance Planning Team. The overall goal of the team is to provide policy direction and procedural guidance on appropriate surveillance planning for NASA-contracted work based on the risk associated with the work and contractor involvement. Team membership includes representatives from the Office of Procurement, the Office of Safety and Mission Assurance, Enterprise Offices, and other Functional Offices. The Office of Procurement also continues to work with the Defense Contract Management Agency, the Defense Contract Audit Agency, and other service providers to ensure that each dollar NASA spends on delegated contract oversight functions returns the best value possible in support of Agency mission objectives.

Electronic Commerce: The Office of Procurement continues to focus on the Internet as a means to achieve rapid, low-cost, reliable delivery of procurement information to broad audiences, especially small and small disadvantaged business concerns. In a recent report (GAO/NSIAD-99-37 February 1999), GAO concluded that the NASA Acquisition Internet Service (NAIS), established as the mechanism to implement electronic commerce by the Office of Procurement, "is a simple, effective, and user-friendly system for disseminating information on contract opportunities." NAIS has won both government and private sector praise for its accomplishments. Since its inception in 1994, NAIS has evolved into a portal that provides a broad range of procurement-related functions and information.

Delivering on one of its key goals, NAIS has streamlined or eliminated many of the steps required by the paper-based process for publicizing synopses of contracting opportunities and issuing solicitations. Contractors have praised the system for allowing them to electronically track contracting opportunities at NASA or to track only certain types of opportunities that best match their core capabilities. Prior to NAIS, contractors would either scan the Commerce Business Daily, or periodically call or visit NASA's procurement offices to identify contracting opportunities. NAIS will continue to expand and refine its offerings as it pursues its objective of being the electronic backbone for the Office of Procurement's various electronic initiatives.

Addressing the Small Business Challenge: In the new century, the world of business is more diverse and more technologically driven. Business and their customers are much more diverse – women, individuals with disabilities, and minority-owned businesses are important players. The rapid pace of technological advances pose both opportunities and challenges for small business. Small businesses are at the forefront of technological change because they are flexible and close to the customer.

Accordingly, NASA's Office of Small and Disadvantaged Business Utilization will continue its effort to increase contract and subcontract dollars awarded to small disadvantaged businesses, particularly in high technology areas. This includes the participation of such firms in NASA's technology transfer and commercialization activities.

For FY 2002, the NASA Administrator has, as part of the overall small disadvantaged business goal, established a specific Agency-wide goal for awards to Historically Black Colleges and Universities and other minority institutions of 1 percent of NASA's total contract and subcontract dollars to increase utilization of these entities. These entities currently receive about 0.5 percent of NASA's total procurement dollars. These new awards will be based upon conformance with NASA's mission needs, technical superiority, and costs reasonableness. It is NASA's expectation that the entire student population of these universities will benefit from these expanded opportunities to satisfy NASA's programmatic requirements.

Objective: Manage our fiscal and physical resources optimally.

Public Benefit: NASA's budget and physical assets represent a significant investment to the American taxpayers, so it is incumbent on the Agency to manage these resources effectively and efficiently to optimize the return to the public on their investment. Agency strategies for ensuring optimal return include partnering, value engineering, outsourcing, performance-based contracting, energy conservation, recycling, and pollution prevention.

Annual Performance Goal: Revitalize Agency facilities and reduce environmental liability. (2MS3)

- Improve facility revitalization rate to 100-year frequency for all facilities as identified by the integrated long-term Agency plan.
- Reduce the Agency's unfunded environmental liability through a long-term strategy, annually investing an amount of not less than 3-5% of the Agency's environmental liability in environmental compliance and restoration funding.

Annual Performance Goal: Improve the Agency's financial management and accountability. (2MS10)

- Cost at least 75% of the resources authority available to cost during the fiscal year.
- Initiate the pilot phase (pilot Center cut-over) of the Core Financial project and initiate at least one other module project.

Addressing Financial Management Challenges:

Integrated Financial Management System: During the fall of 2000, the IFM program was totally restructured. The contract with the incumbent system developer,was terminated. The critical need for new integrated financial management systems was reaffirmed by the Agency leadership and an extensive planning effort was initiated. The program concept was significantly modified based on successful benchmarks from both the commercial and federal sectors. Rather than pursue a large-scale implementation approach, individual projects for specific functions were created based on the availability of commercial software applications. A best of suite strategy was adopted where Core Financial system requirements would drive the selection of an Enterprise Resource Planning (ERP) application. The ability of that application to be extended to fill a number of the other IFM requirements, as well as past performance in successful implementations, were key selection criteria.

An Agency-level project team is in place at the Marshall Space Flight Center, the Lead Center for the project, and the design phase will begin in February 2002. In addition, three "pathfinder" projects have begun to test out the processes and technical requirements for Agency-wide implementation of new administrative systems. The Langley Research Center is leading implementation of a new Travel Management system, and the Goddard Space Flight Center is leading projects for Resume Management and Position Description Management. All three of these projects will be complete before the Core Financial Project enters the implementation phase.

Obligations Management: The Office of the Chief Financial Officer has worked closely with the Office of Inspector General (OIG) to address the obligations management challenges compiled by the OIG in its December 1, 2000 report. The issue of matching Agency disbursements to obligations was resolved with the publication of a November 2000 revision to the Financial Management Manual (FMM) 9011-5, which provided further written clarification of NASA's existing practices in this area. Matters discussed in the OIG audit of internal controls over processing deobligations were resolved through the Langley Research Center and Marshall Space Flight Center review of the transactions in question (the review established that these transactions were valid), and through the October 24, 2000 publication of new guidance in FMM 9041-17 regarding the recording of deobligations and required supporting documentation. Finally, the error in the preparation of the 1999 Statement of Budgetary Resources was a Headquarters' reporting error which had no budgetary impact; it was not an indication "…that significant uncertainty exists regarding how to properly manage obligations."

Objective: Enhance the security, efficiency, and support provided by our information technology resources.

Public Benefit: The public's investment in NASA ensures that the Agency's explorers, pioneers, and innovators can continue to expand frontiers in air and space. But, NASA's missions to advance and communicate scientific knowledge and understanding of the Earth, the solar system, and the universe, to use and develop space, and to research, develop, verify, and transfer advanced aeronautics and space technologies require optimal efficiencies in the use of NASA's limited Information Technology (IT) resources. To achieve this goal, NASA's IT planning is focused on four areas: safety and security, cost-effective common infrastructure and services, innovative technology and practices, and emerging IT areas (e.g., e-Business and e-Government).

Annual Performance Goal: Improve IT infrastructure service delivery by providing increased capability and efficiency while maintaining a customer rating of satisfactory. (2MS4)

- Improve IT infrastructure service delivery to provide increased capability and efficiency while maintaining a customer rating of satisfactory and holding costs per resource unit to established baselines for each major IT service.

Service	Established Cost Baseline
NASA ADP Consolidation Center (NACC)	$3.5 M per Processing Resource Unit
NASA Integrated Services Network (NISN)	$0.78/ KBPS per month
Outsourcing Desktop Initiative for NASA (ODIN)	$2,940 per Standard Workstation

Annual Performance Goal: Enhance IT security by meeting established performance indicators in three critical areas: Vulnerabilities Detected; Training; and IT Security Plans. (2MS5)

- Reduce known system vulnerabilities across all NASA Centers to at least the established target ratios (10 percent of systems scanned).
- Provide IT security awareness training to NASA employees, managers, and system administrators at or above targeted levels (below).
- Complete 90 percent of ITS plans for critical systems, including authorization to process.

IT Security Element	FY 2002 Target
Percentage Vulnerabilities Detected to Systems Scanned	10%
ITS Awareness Training:	
Civil Service Employees	80%
Civil Service Managers	95%
Civil Service System Administrators	90%
IT Security Plans completed for critical systems	90%

Annual Performance Goal: Enhance mission success through seamless, community-focused electronic service delivery. (2MS6)

- Develop the eNASA Strategic Plan and Roadmap to deliver electronic services and information to the public, partners, suppliers, key stakeholders, and the internal employees and teams that execute NASA's missions.
- Make the NASA Web more accessible, community-focused, and useful to all of NASA's diverse audiences as demonstrated by increased customer satisfaction from the FY 01 baseline survey results.
- Increase the scope and level of corporate and shared electronic services from the FY01 baseline.
- Implement digital signatures that are accepted by Federal Agencies for secure online communications.
- Post a majority of the NASA grants announcements online by the end of FY02, consistent with interagency efforts such as the Federal Commons Initiative which seeks to automate the Federal grants process.

Addressing the IT Management Challenge: While IT Security remains a significant area of management concern, the Agency has made an extensive, concerted effort to improve IT security. This effort has been framed by several audits: a 1998 review by Agency staff; several Inspector General audits; and a 1999 report by the General Accounting Office. The evaluations concluded that significant improvements were needed to counteract the threat to critical systems. NASA responded vigorously to the recommendations during 1999 and the first half of 2000 with an aggressive program to remedy deficiencies as quickly as possible. The IT security objectives established include:

- Improving adherence to Agency IT security policy;
- Reducing system and application vulnerabilities;

- Improving intrusion monitoring, reporting, and response;
- Achieving a trained workforce of users, managers, system administrators, and network administrators; and
- Improving mechanisms for user authentication and data protection.

In FY 2000, NASA started a Vulnerability Reduction Program to identify and target a list of high-risk exploits and vulnerabilities and to take steps to reduce the vulnerability. NASA has installed a common set of network auditing tools to scan systems for a set of known vulnerabilities; the number of vulnerabilities per system has been reduced. In FY 2002, NASA will update the set of vulnerabilities to be scanned across the agency to reflect the evolving threat.

In FY 2000, NASA also installed a common set of intrusion monitoring tools to improve detection of attacks on systems and to make it easier to determine whether an attack experienced by one Center is also being conducted against other Centers. The success of the network monitoring is evidenced by a four-fold decrease in the ratio of successful attacks to attempted attacks in FY 2000.

Both the GAO audit and the internal IT security program review noted that the NASA IT security training practices were inadequate and inconsistent. To address these criticisms, NASA conducted IT security awareness training for employees and onsite contractors and specialized IT security training for managers. Since system and network administrators are the first line of defense in protecting NASA's IT assets from intrusions and detecting intrusions when they do occur, more specialized training for this group is planned for FY 2001 and 2002. The use of web-based training enables the Agency to broaden course offerings, simplify distribution, and make training available to any employee who has access to the Internet.

In FY 2000, NASA also began a concerted effort to update the IT security plans for critical systems, including signed authorization to process. In FY 2002 NASA will complete this effort for Special Management Attention Systems, Mission systems, and systems with Business and Restricted Technology data. While substantial progress has been made in closing out most of the IT-security recommendations, NASA will continue making IT security an integral part of all systems operated by the Agency. NASA acknowledges that significant improvements must be followed by a focused, ongoing effort.

Objective: Invest wisely in our use of human capital, developing and drawing upon the talents of all our people.

Public Benefit: NASA's human capital investment strategies are rooted in the Agency's belief that employees are our most important resource. Therefore, to deliver on our research and development commitments to the public, NASA manages this resource consistent with changing Agency goals and objectives. In addition, NASA is committed to attracting and retaining a workforce that is: (1) representative at all levels of the diverse public it serves; and (2) renowned for its world-class, cutting-edge skills and competencies. To ensure that we retain a skilled, creative, and effective human resources capability that meets taxpayer expectations, NASA is striving to anticipate future human capital planning challenges and workforce issues as the Agency moves away from operations and toward its primary mission of research, development, and scientific discovery.

Annual Performance Goal: Align management of human resources to best achieve Agency strategic goals and objectives. (2MS7)

- By September 30, 2002, develop, test, and evaluate at each NASA Center a prototype of a consistent, Agency-wide workforce planning and reporting system that incorporates the current FAIR Inventory process.
- Develop an initiative to enhance Centers' recruitment capabilities, focusing on fresh-outs.
- Maintain, on an Agency-wide basis (excluding the Inspector General), the supervisor to employee ratio of 1:10 within a range of ± .5.

Additionally, to emphasize recruitment and revitalization of a diverse NASA workforce, our annual performance goal is:

Annual Performance Goal: Attract and retain a workforce that is representative at all levels of America's diversity. (2MS8)

- During the fiscal year, increase representation of minorities by at least 0.6 percent, women by at least 0.4 percent, and individuals with targeted disabilities by at least .085 percent.

Addressing the Human Capital Management Challenge: Over the last several years, NASA has aggressively conducted a series of internal reviews designed to reduce the size of the NASA workforce while continuing to focus on safety and mission success. Between FY 1993 and FY 2000, the Agency experienced a 26 percent civil servant reduction (with the Headquarters reduced by more than 50 percent); achieved a 15 percent reduction in Senior Executive Service positions Agency-wide (exceeding the mandated 10 percent reduction); and increased, on an Agencywide basis (excluding the Inspector General), the supervisor to employee ratio from 1:6 to 1:10. During FY 2000, NASA renewed the Agency's focus on the restructure and revitalization of the NASA workforce.

NASA's human capital management strategy centers on:

- attracting and retaining a high caliber, high tech, and diverse workforce whose skills and competencies are aligned with Agency mission objectives;
- investing in the technical training and career development of this critical resource; and
- cultivating a continued pipeline of talent to meet future science, math, and technology needs.

In formulating its strategy, the Agency has considered findings and recommendations contained in both internal reviews and external reports touching on human capital issues, including those of the Aerospace Safety Advisory Panel, the Office of Management and Budget, and the General Accounting Office.

In FY 2001, the Agency began a strategic resource planning activity, based on Centers' future vision and mission and taking into account critical workforce capabilities and facilities needed. Building on that activity in FY 2002, the Agency will in develop a process by which Centers will implement consistent workforce planning. The result will be a plan for each Center that links staffing, funding resources, mission and activities, and core competencies. It will enable the Centers to focus on recruitment, retention, training, succession and career development tailored to their individual circumstances while supporting Agency goals and objectives. This effort, in concert with identifying tools and flexibilities to recruit and retain needed skills, will enable NASA to have the right people in the right place at the right time to ensure mission success and safety. A Management Advisory Committee also has been established to review NASA's organization structure. It will complete a study of ways to delayer

management levels to streamline organizations and develop an implementation plan. The study will focus on deputy positions and explore other rebalancing measures.

The Agency initiated a strategy in FY 2000 to accomplish work through a balance of permanent civil servants, time-limited civil service appointees, and individuals from the academic world who contribute through post-doctoral fellowships, grants programs, Intergovernmental Personnel Act assignments, or other partnerships. The intent is to draw from a variety of sources to ensure the effective use of talent both within and outside the Agency. The use of non-permanent civil servants, where it makes sense, can be a means to infuse the NASA workforce with fresh ideas and allow the Agency to make changes quickly and efficiently with minimal adverse impact on the core workforce. Combined with support from contractors (approximately 85 percent of NASA's annual budget is contracted out), this approach will permit the Agency to focus on being a premier research and development organization – doing the things that NASA does best and relying on others to take on operations and other appropriate functions.

To counterbalance the aging of the workforce due to the halt in the influx of new college graduates during the years of downsizing, NASA intends in FY 2002 to develop an initiative to enhance Centers' recruitment capabilities, focusing on hiring fresh-outs. The Agency also continues to look for ways to help assure a future pipeline of talent from which NASA and others can draw. For example, FY 2001 marks the pilot year of the new NASA Undergraduate Student Research Program. This Agency-wide program was developed to extend and strengthen NASA's commitment to educational excellence and university research and to highlight the critical need to increase the Nation's undergraduate and graduate science, engineering, mathematics, and technology skill base. The Undergraduate Student Research Program also will build a national program bridge from existing NASA K-12 Education Program activities to other NASA Higher Education Program options that encourage and facilitate student interest in future professional opportunities with NASA and its partner organizations. Such opportunities might include NASA career employment, temporary assignment, undergraduate and graduate co-op appointment; or contractor positions.

Equally important to attracting the right people is the need to train and develop that talent. Agency expenditures for training and development of the NASA workforce increased from $30 million in 1997 to over $47 million in 2000 – from 2.5 percent of salary in FY 1997 to 3.6 percent of salary in FY 2000. In addition to funding more university level courses, the Agency has made a strong investment in ensuring NASA participation in conferences and symposia, where breakthrough research and ideas are being presented and shared, as well as providing training in other core functional areas. Emphasis is being placed on "just in time" training and coaching opportunities for project leader and team members to improve project team competencies, and efforts are being initiated to establish a network of experienced practitioners who can provide mentoring and access to expertise in project management. NASA also has updated its leadership model specifying the latest cutting edge skills and behaviors required for effective leadership. The model is linked to NASA's Strategic Plan and defines skill requirements for team leaders through senior executives. NASA requested additional FY 2002 resources to expand training delivery methods and emphasize the development of e-learning alternatives that can be accessed at all locations and levels.

NASA recognizes its greatest strength is its people – essential to safe operations, mission success, and responsible stewardship of the taxpayers' dollars. The Agency will continue to pursue focused activities to position NASA as an employer of choice, recruit and retain the best talent, and provide learning and developmental opportunities for the workforce.

Additional Management Challenges

Environmental Management

The Environmental Management Division in NASA's Office of Management Systems takes a very proactive and integrated approach to environmental management. Consistent with the strategy articulated in "NASA Environmental Excellence for the Twenty-First Century," the Agency is working on the immediate priority of bringing all NASA activities into compliance with current environmental requirements, while simultaneously restoring previously contaminated sites as quickly as funds allow. Conservation and pollution prevention will be considered in all new projects and programs to minimize environmental impacts and preserve our natural and cultural resources. This approach is clearly captured in NASA's environmental vision that "we will continue as a world leader in space exploration and aeronautics while maintaining environmental excellence." The strategy for achieving this vision includes four focus areas: prevention, compliance, restoration, and conservation. In this FY 2002 performance plan, the Agency has included performance metrics in the areas of compliance (2MS1) and restoration (2MS3).

In terms of specific areas of management concern, the decommissioning of the Plum Brook Reactor and consistent implementation of the National Environmental Policy Act (NEPA) are receiving focused attention by NASA management. In fact, both issues are on NASA's Top 10 Environmental Priorities in the current Environmental Management Division FY 2001 Operating Plan, with the Plum Brook reactor ranking as the top priority. The first five priorities are concerned with mandatory requirements that characteristically have associated legal liabilities. The second five priorities emphasize "best management practices" that offer the Agency the greatest benefits in terms of efficiency, effectiveness and cost. By placing emphasis on achieving the 10 priorities, NASA will greatly improve its legal and management situation in the area of environmental management.

Specifically, regarding the Nuclear Reactor Facility Decommissioning, Sandusky, Ohio, NASA has submitted a Decontamination and Decommissioning Plan to the Nuclear Regulatory Agency for review. Further, NASA has partnered with the U.S. Army Corps of Engineers to manage the decommissioning work aspects and included the decommissioning project in our budget request. The selected contractor and subcontractors are currently completing the necessary plans and required documentation prior to starting the decommissioning work.

Regarding National Environmental Policy Act (NEPA) Implementation, NEPA requires that NASA evaluate potential environmental impacts of proposed Federal actions as early as possible in the program/planning process. Management controls need to be strengthened to ensure greater visibility of and more consistent implementation of the NEPA process. Review of existing management controls, development and advocacy of improvements, and training activities have been planned and are being initiated.

International Technology Transfer/Export Control

The challenges concerning NASA's management of international agreements, and particularly international technology transfers, have been addressed through several processes. First, NASA issued two Federal Register notices amending the NASA Federal Acquisition Regulations (FAR) Supplement in February 2000 (see 65 Fed. Reg. 10031, February 25, 2000; 65 Fed. Reg. 6915, February 11, 2000). These new NASA FAR Supplement provisions remind NASA contractors of their obligations to comply with U.S. export control laws and regulations, and also provide specific notice regarding record-keeping requirements pertaining to contractor export activities within the scope of NASA-sponsored programs. Additionally, NASA is currently reviewing those FAR Supplement provisions with a view towards further amendments, as appropriate, to elaborate on the availability of Government-authorized export license exemptions.

Second, in response to recommendations from the NASA Inspector General, NASA is clarifying the definition of "foreign national" in its foreign visitors policy to ensure appropriate and consistent use of the term in the Agency's foreign visitors review program.

Finally, NASA has established an Agency-wide foreign national management information system to process all foreign national visitors to NASA facilities. This system is a state-of-the-art secure database that allows for each NASA facility to process requests for foreign nationals' access to NASA facilities, consistent with NPG 1371.2, and further provides an on-line system for NASA Headquarters program, desk officer, and International Visitor Control Authority review and approval or denial of visitors from designated areas.

Verification/Validation

Performance plan goals, indicators, and accomplishment claims are subject to audit by a number of internal and external groups. Therefore, we must be able to prove that we accomplished what we claim we accomplished, and we need to be able to document this proof. To ensure this capability, NASA relies on a number of processes for verifying and validating performance claims.

First, whenever possible, data in support of performance claims is gleaned from and/or validated against officially-maintained databases. The data-gathering process in all cases is subject to strict oversight. The integrity of each database also is ensured through independent audits and periodic checks by internal and/or external reviewers. These databases include: the NASA Personnel Payroll System (NPPS); the Consolidated Agency Payroll and Personnel System (CAPPS); the Incident Reporting System (IRIS); the Financial and Contractual Status of Programs System (FACS); the NASA Environmental Tracking System (NETS); the Veterans Administration Workers' Compensation Database; the consolidated NASA Occupational Health Annual Cost and Staffing Report; NASA Center Personal Property Reports; and the Center Cost Avoidance Database.

Second, a number of specific verification and validation processes are in place to support performance claims in specific areas. These include the following:

1. Integrated Financial Management System (IFMS) verification and validation are based on measures in the signed Program Commitment Agreement. Non-advocate and independent reviews are conducted periodically, and the results are reported to the HQ Program Management Council (PMC) and the IFM Council.

2. Performance Based Contracts (PBCs) are verified and validated three ways. First, PBCs are sampled routinely to ensure that each meets the criteria for designation as a PBC. Second, Occupational Health Quality Assurance Audits provide data to validate contract claims in the areas of health and safety. And, third, reviewers use the FACS database for verification checks.

3. Contract awards to small and small disadvantaged businesses are documented for verification and validation in the Summary Contractor Reports (SF 295) that are reviewed during Center Procurement Management Survey data checks. In addition, the Small Business Administration and the Department of Defense Contract Management Agency conduct periodic on-site surveys to verify and validate performance claims and process integrity, and the Minority Business Resource Advisory Council and the NASA/Prime Contractor Roundtable also do periodic reviews and make recommendations for process improvements to NASA management.

4. Information Technology (IT) performance data are verified and validated by periodic reviews conducted by a number of process overseers, including NASA and Center Chief Information Officers, staff of the NASA ADP Consolidation Center (NACC), project office staff of the NASA Integrated Services Network (NISN), and project office staff of the Outsourcing Desktop Management Initiative (ODIN). In addition, NASA's IT customers are given frequent opportunities to offer evaluations and recommendations for improved IT performance.

NASA continues to seek new verification and validation techniques for on-going performance indicators and to develop additional performance indicators that can be verified and validated with precision.

MULTI-YEAR PERFORMANCE TREND
Manage Strategically Crosscutting Process

Protect the safety of our people and facilities and the health of our workforce.

	FY 1999	**FY 2000**	**FY 2001**	**FY 2002**
Annual Performance Goal and APG #	Reduce the number of Agency lost workdays (from occupational injury or illness) by 5 percent from the FY 1994-96 3-year average. (#MS3) Achieve a 5% increase in physical resource costs avoided from the previous year through alternative investment strategies in environmental and facilities operations. (#MS4)	Reduce the number of Agency lost workdays (from occupational injury or illness) by 5% from the FY 1994-96 3-year average. (#0MS3) Achieve a 5% increase in physical resource costs avoided from the previous year through alternate investment strategies in environmental and facilities operations. (#0MS12)	NASA will increase the safety of its infrastructure and workforce with facilities safety improvements, reduced environmental hazards, increased physical security, and enhanced safety awareness among its employees by meeting all 5 performance indicators in this area. (#1MS1)	NASA will increase the safety of its infrastructure and the health of its workforce through facilities safety improvements, reduced environmental hazards, increased physical security, enhanced safety and health awareness, and appropriate tools and procedures for health enhancement. (#2MS1)
Assessment	#3 was green. #4 was green.	OMS3 was blue. OMS12 was blue.		

Achieve the most productive application of Federal acquisition policies.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	Increase obligated funds available for Performance Based Contracts to 80% (funds available exclude grants, cooperative agreements, actions <$100,000, Small Business Innovative Research, Small Business Technology Transfer Programs, Federally Funded Research and Development Centers, intragovernmental agreements, and contracts with foreign governments or international organizations). (#MS6)	Of funds available for Performance Based Contracts, maintain PBC obligations at 80% (funds available exclude grants, cooperative agreements, actions <$100,000, SBIR, STTR, FFRDCs, intragovernmental agreements, and contracts with foreign governments or international organizations). (#0MS5)		
Assessment	Green	Green		
Annual Performance Goal and APG #	Achieve at least the congressionally mandated 8-percent goal for annual funding to small disadvantaged businesses (including prime and subcontractors to small disadvantaged businesses, Historically Black Colleges and Universities, other minority educational institutions, and women-owned small businesses). (#MS7)	Achieve at least the congressionally mandated 8% goal for annual funding to small disadvantaged businesses (including prime and subcontractors, small disadvantaged businesses, Historically Black Colleges and Universities, other minority institutions, and women-owned small businesses). (#0MS8)		
Assessment	Green	Blue		

Achieve the most productive application of Federal acquisition policies.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	Enhance contract management through improved systems and information for monitoring and through an emphasis on the training of procurement personnel, and revise metrics to assess the overall health of the procurement function. (#MS9) Enhance contract management through improved systems and information for monitoring by implementing a strategy for evaluating the efficacy of procurement operations. (#MS10)		Continue to take advantage of opportunities for improved contract management by maintaining a high proportion of Performance Based Contracts and maintain a significant involvement in NASA programs of small businesses, minority institutions, and minority and women-owned businesses by meeting 2 out of 2 performance indicators in this area. (#1MS2)	Continue to take advantage of opportunities for improved contract management by maintaining a high proportion of Performance Based Contracts (PBCs). (#2MS2) Continue integrating small, small disadvantaged, and women-owned businesses together with minority universities into the competitive base from which NASA can purchase goods and services. (#2MS9)
Assessment	All targets were green.		TBD	TBD

Manage our fiscal and physical resources optimally.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	Achieve 70 percent or more of the resources authority available to cost within the fiscal year. (#MS5) Complete system validation of the Integrated Financial Management Program, and complete system implementation at Marshall and Dryden. (#MS12)	Cost 70% or more of available resources. (#0MS4) Begin the implementation at NASA installations of the Integrated Financial Management System following the completion of system testing. (#0MS11)	Renew Agency's management systems, facilities, and human resources through updated use of automated systems, facilities revitalization, and personnel training by meeting 4 out of 7 performance indicators in this area. (#1MS3) NOTE: This target is also a precursor to #2MS7 and #2MS8.	Revitalize Agency facilities and reduce environmental liability. (#2MS3) Improve the Agency's financial management and accountability. (#2MS10)
Assessment	#MS5 was green. #MS12 was red.	OMS4 was green. OMS11 was red.	TBD	TBD

Enhance the security, efficiency, and support provided by our information technology resources.

	FY99	FY00	FY01	FY02
Annual Performance Goal and APG #	Improve information technology infrastructure service delivery to provided increased capability and efficiency while maintaining a customer rating of "satisfactory" and holding costs per resource unit to the FY 1998 baseline. (#MS8) Complete remediation of mission-critical systems by March 1999, consistent with Government-wide guidance for the Year 2000. (#MS11)	Improve information technology infrastructure service delivery to provide increased capability and efficiency while maintaining a customer rating of "satisfactory" and holding costs per resource unit to the FY 1998 baseline. (#0MS10)	Improve IT infrastructure service delivery to provide increased capability and efficiency while maintaining a customer rating of "satisfactory," and enhance IT security through a reduction of system vulnerabilities across all NASA centers, emphasizing IT security awareness training for all NASA personnel, by meeting 2 out of 2 performance indicators in this area. (#1MS4)	Improve IT infrastructure service delivery by providing increased capability and efficiency while maintaining a customer rating of satisfactory. (#2MS4) Enhance IT security by meeting established performance indicators in three critical areas: vulnerabilities detected, training, and IT security plans. (#2MS5) Enhance mission success through seamless, community-focused electronic service delivery. (#2MS6)
Assessment	All targets were green.	OMS10 was green.		

Invest wisely in our use of human capital, developing and drawing upon the talents of all our people.

	FY99	FY00	FY01	FY02
Annual Performance Goal and APG #	Reduce the civil service workforce to below 19,000. (#MS1) Maintain a diverse NASA workforce through the downsizing efforts. (#MS2)	Reduce the civil service workforce to below 18,200. (#0MS1) Maintain a diverse NASA workforce through the downsizing efforts. (#0MS2)	Renew Agency's management systems, facilities, and human resources through updated use of automated systems, facilities revitalization, and personnel training by meeting 4 out of 7 performance indicators in this area. (#1MS3) NOTE: This target is also a precursor to #2MS3 and #2MS10.	Align management of human resources to best achieve Agency strategic goals and objectives. (#2MS7) Attract and retain a workforce that is representative at all levels of America's diversity. (#2MS8)
Assessment	All targets were green.	OMS1 was no longer applicable. OMS2 was green.		

Manage Strategically FY 2002	Budget Category	HEDS	Biological and Physical Research	Aero-Space Technology	Space Science	Earth Science	Research & Program Management
Annual Performance Goals							
2MS1: NASA will increase the safety of its infrastructure and the health of its workforce through facilities safety improvements, reduced environmental hazards, increased physical security, enhanced safety and health awareness, and appropriate tools for health enhancement.		X	X	X	X	X	X
2MS2: Continue to take advantage of opportunities for improved contract management by maintaining a high proportion of Performance Based Contracts (PBCs).		X	X	X	X	X	X
2MS9: Continue integrating small, small disadvantaged, and women-owned business together with minority universities into the competitive base from which NASA can purchase goods and services.		X	X	X	X	X	X
2MS3: Revitalize Agency facilities and reduce environmental liability.		X	X	X	X	X	X
2MS10: Improve the Agency's financial management and accountability.		X	X	X	X	X	X
2MS4: Improve IT infrastructure service delivery by providing increased capability and efficiency while maintaining a customer rating of satisfactory.		X	X	X	X	X	X
2MS5: Enhance IT security by meeting established performance indicators in three critical areas: Vulnerabilities Detected; Training; and IT Security Plans.		X	X	X	X	X	X
2MS6: Enhance mission success through seamless, community-focused electronic service delivery.		X	X	X	X	X	X
2MS7: Align management of human resources to best achieve Agency strategic goals and objectives.		X	X	X	X	X	X
2MS8: Attract and retain a workforce that is representative at all levels of America's diversity.		X	X	X	X	X	X

Provide Aerospace Products and Capabilities Crosscutting Process

Mission

The Provide Aerospace Products and Capabilities (PAPAC) process is the means by which NASA's Strategic Enterprises and their Centers deliver systems (ground, aeronautics, space), technologies, data, and operational services to NASA customers. Through the use of Agency facilities, customers can conduct research, explore and develop space, and improve life on Earth. This process is used to answer the Agency's fundamental question: "What cutting-edge technologies, processes, techniques, and engineering capabilities must we develop to implement our research agenda in the most productive, economical, and timely manner?" PAPAC helps to assure that NASA strategically utilizes public resources in an efficient and effective means such that the public benefit is maximized.

Implementation Strategy

The goal of this process is to enable NASA's Strategic Enterprises and their Centers to deliver products and services to customers more effectively and efficiently. The process is also used to enable the Communicate Knowledge process to extend the technology, research, and science benefits from NASA programs broadly to the public and commercial sectors. Several of the objectives and targets address the NASA Integrated Action Team (NIAT) report actions.

Performance Measures

Goal: Enable NASA's Strategic Enterprises and their Centers to deliver products and services to customers more effectively and efficiently.

Objective - Enhance Program safety and mission success in the delivery of products and operational services.

Public Benefit: NASA's role in the advancement of research and technology is conducted through the construction and operation of facilities such as telescopes, satellites, and ground-based laboratories and test facilities. This element affects the effectiveness and efficiency with which NASA's Strategic Enterprises and Centers serve their customers.

Annual Performance Goal 2P1: Meet schedule and cost commitments by keeping development and upgrade of major scientific facilities and capital assets within 110% of cost and schedule estimates, on average.

- Development schedule and cost data are drawn from NASA budget documentation for major programs and projects to calculate the average performance measures.

Annual Performance Goal 2P2: Track the availability of NASA's spacecraft and major ground facilities by keeping the operating time lost due to unscheduled downtime to less than 10% of scheduled operating time.

- Each field center reports the operational downtime of the major spacecraft and ground facilities.

Objective - Improve NASA's engineering capability to remain as a premier engineering research and development organization

Public Benefit: NASA's ability to improve and maintain engineering capabilities results in more efficient processes and reduced cost.

Annual Performance Goal 2P3: Strengthen the NASA engineering capability through the completion of two indicators in FY 2002.

- Complete an assessment to identify a suitable systems engineering standard for NASA. Document the standard in the appropriate NASA system (ex. NASA Procedures and Guidelines (NPG)).
- Conduct an assessment of the systems engineering capability based upon the identified systems engineering standard (NPG) to identify target areas for improvement.

Objective - Capture engineering and technological best practices and process knowledge to continuously improve NASA's program/project management

Public Benefit: NASA's improvements in program and project management yields an increased number of successful missions within budget, an increase of information to the public, more technological breakthroughs, and more discoveries about our planet and universe.

Annual Performance Goal 2P4: Improve program and project management through the completion of two of the three indicators in FY 2002.

- Benchmark high-tech, successful commercial companies and government organizations and apply the results to revise NASA's program project management.
- Increase the number of program and project managers completing the Advanced Program Management Training compared to the number that completed the training in FY 2001.
- Complete the incorporation of NIAT actions into NASA policy.

Annual Performance Goal 2P5: Capture a set of best practices/lessons learned from each Program, to include at least one from each of the four PAPAC subprocesses, commensurate with current program status.

- Lessons learned from the PAPAC subprocesses are collected and utilized in process improvement and project and program training by the Program Management Council Working Group (PMCWG) and Code FT (Training and Development Division).

Objective - Facilitate technology insertion and transfer, and utilize commercial partnerships in research and development to the maximum extent practicable

Public Benefit: The percentage of NASA's R&D budget dedicated to commercial partnerships affects integrated technology planning and development with NASA partners. This reduces the taxpayer cost while increasing products and services to the consumer.

Annual Performance Goal 2P6: Dedicate 10 to 20 percent of the Agency's Research & Development budget to commercial partnerships.

- Each of the Enterprises reports contribution to commercial partnerships.

Verification and Validation

Data will be verified by collaborating with the Enterprises and Centers, and during the Quarterly Status Reviews and monthly status reports.

Data will be validated by various independent assessments of program/project activity, and the review of several Center and Agency databases.

MULTI-YEAR PERFORMANCE TREND

Provide Aerospace Products and Capabilities (PAPAC)

Enhance Program safety and mission success in the delivery of products and operational services.

	FY 1999	**FY 2000**	**FY 2001**	**FY 2002**
Annual Performance Goal and Goal #	P1: Meet schedule and cost commitments by keeping development and upgrade of major scientific facilities and capital assets within 110% of cost and schedule estimates, on average.	0P1: Meet schedule and cost commitments by keeping development and upgrade of major scientific facilities and capital assets within 110% of cost and schedule estimates, on average.	1P1: Meet schedule and cost commitments by keeping development and upgrade of major scientific facilities and capital assets within 110% of cost and schedule estimates, on average.	2P1: Meet schedule and cost commitments by keeping development and upgrade of major scientific facilities and capital assets within 110% of cost and schedule estimates, on average.
Assessment	Green	Red	TBD	TBD
Annual Performance Goal and Goal #	P2: Set up process to determine, on average, the operating time of NASA's spacecraft and ground facilities lost to unscheduled downtime. Establish a baseline in FY99.	0P2: Ensure the availability of NASA's spacecraft and facilities by decreasing the downtime relative to FY1999 spacecraft and facility performance.	1P3: Ensure the availability of NASA's spacecraft and major ground facilities by keeping the operating time lost due to unscheduled downtime to less than 10% of scheduled operating time.	2P2: Track the availability of NASA's spacecraft and major ground facilities by keeping the operating time lost due to unscheduled downtime to less than 10% of scheduled operating time.
Assessment	Green	Blue	TBD	TBD
Annual Performance Goal and Goal #			Develop and approve NASA policy for Software Independent Verification and Validation, and conduct an evaluation of projects for its application through achievement of three indicators. (1P7)	
Assessment			TBD	

Improve NASA's engineering capability to remain as a premier engineering research and development organization

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and Goal #	P8: Set up process to improve engineering skills and tools within the Agency.			2P3: Strengthen the NASA engineering capability through the completion of two indicators in FY02.
Assessment	Yellow			TBD

Capture engineering and technological best practices and process knowledge to continuously improve NASA's program/project management

Annual Performance Goal and Goal #				2P4: Improve program and project management through the completion of two of three indicators in FY02.
Assessment				TBD
Annual Performance Goal and Goal #	P5: Set up a process in FY99 to capture a set of best practices/lessons learned from each Program, to include at least one from each of the four PAPAC subprocesses, commensurate with current program status.	0P5: Capture a set of best practices/lessons learned from each Program, to include at least one from each of the four PAPAC subprocesses, commensurate with current program status. Inputs will be used in PAPAC process improvement and in Program/Project Management training.	1P4: Capture a set of best practices/lessons learned from each Program, to include at least one from each of the four PAPAC subprocesses, commensurate with current program status. Inputs will be used in PAPAC process improvement and in Program/Project Management training.	2P5: Capture a set of best practices/lessons learned from each Program, to include at least one from each of the four PAPAC subprocesses, commensurate with current program status.
Assessment	Green	Yellow	TBD	TBD

Facilitate technology insertion and transfer, and utilize commercial partnerships in research and development to the maximum extent practicable

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and Goal #	P6: Set up a process to determine percent of Agency's R & D budget dedicated to commercial partnerships and establish a baseline.	0P6: Dedicate the percentage of the Agency's R&D budget that is established in the FY00 process to commercial partnerships.	1P5:Dedicate 10 to 20 percent of the Agency's Research & Development budget to commercial partnerships.	2P6: Dedicate 10 to 20 percent of the Agency's Research & Development budget to commercial partnerships.
Assessment	Green	Blue	TBD	TBD

Enable technology planning, development, and integration driven by Strategic Enterprise customer needs

Annual Performance Goal and Goal #	P7: Set up a data collection process to determine the amount of leveraging of the R and D budget with activities of other organizations. Establish a baseline in FY99.	0P7:Increase the amount of leveraging of the technology budget with activities of other organizations, relative to the FY99 baseline that is established during process development.	1P6: Complete redefinition of the NASA Technology Plan to emphasize investments in the emerging strategic cross-Enterprise technology areas & include roadmaps for each Enterprise to show how Enterprise technology investments are linked to future mission needs.	
Assessment	Green	Green	TBD	

Provide Aerospace Products and Capabilities (PAPAC)	Budget Category	Space Science	Earth Science	Biological and Physical Research	HEDS	Aero-Space Technology	Research & Program Management
Annual Performance Goal and APG#							
Meet schedule and cost commitments by keeping development and upgrade of major scientific facilities and capital assets within 110% of cost and schedule estimates, on average. (2P1)		X	X	X	X	X	
Track the availability of NASA's spacecraft and major ground facilities by keeping the operating time lost due to unscheduled downtime to less than 10% of scheduled operating time. (2P2)		X	X	X	X	X	X
Strengthen the NASA engineering capability through the completion of two indicators in FY02. (2P3)							X
Improve program and project management through the completion of two of three indicators in FY02. (2P4)							X
Capture a set of best practices/lessons learned from each Program, to include at least one from each of the four PAPAC subprocesses, commensurate with current program status. (2P5)		X	X	X	X	X	X
Dedicate 10 to 20 percent of the Agency's Research & Development budget to commercial partnerships. (2P6)		X	X	X	X	X	

Communicate Knowledge Crosscutting Process

Mission

NASA communicates knowledge by coordinating, managing and sharing information and experiences related to the content, relevance, results, applications, and excitement of NASA's mission. The Communicate Knowledge (CK) process facilitates the distribution of information on NASA's missions and discoveries. It ensures increased public understanding of science and technology, promotes the application of NASA-generated information, and inspires achievement and innovation. The process ensures that knowledge derived from NASA research programs is available to meet the specific needs and interests of constituent groups. It begins at the inception of a research project and increases in intensity as the effort reaches maturity to ensure the appropriate delivery, archiving, and future convenient access of all research results. The goal of the Communicate Knowledge Process is to ensure that NASA's customers (including scientists and technologists around the world, companies and innovators, educators, publishers, museums, the media, and every citizen) receive information derived from the Agency's efforts in a timely and useful form.

Implementation Strategy

The Agency will work to expose more people to the activities of NASA's Aeronautics and Space programs by maintaining an exhibits loan service, a fine-arts program, and by providing live satellite interviews with astronauts, program managers, and other Agency officials. Through increased availability of documentation and digital images, the Agency will provide scientists and the public greater access to NASA generated knowledge. Scientific Technical Information (STI) is a service that provides for collection, organization, and archiving of NASA's STI and as such, is a unique resource to the public. The Agency will also improve utility of NASA World Wide Web pages and ease of locating areas of interest - based on the public's demand. NASA will increase the opportunities for transferring technology to private industry and the public through the Internet using the *NASA TechTracS* database, by producing a series of technology publications, and by attending industry specific conferences and trade shows. The Agency involves the educational community in its endeavors to inspire America's students, create learning opportunities, and enlighten inquisitive minds. This will be accomplished by providing opportunities for students and educators at all levels to become involved in our mission; providing excellent and valuable education programs and services as judged by our customer, the education community; increasing the number of sites that offer science and engineering curriculum to the underrepresented and minority students; and increasing the involvement of minority universities through sponsored research projects.

The Objectives described in the NASA Strategic Plan for this cross-cutting process are:

- Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable
- Disseminate scientific information generated by NASA programs to our customers
- Transfer NASA technologies and innovations to private industry and the public sector
- Support the Nation's education goals

Performance Measures

The Agency has defined 4 CK Annual Performance Goals for Fiscal Year 2002. Each goal has specific indicators that will provide a quantitative manner to measure performance. The goals are listed in the text below.

Goal: Ensure that NASA's customers receive information from the Agency's efforts in a timely and useful form.

Objective: Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable.

Public Benefit: American citizens can experience NASA in ways that are meaningful and useful to them, by participating in NASA supported events.

Annual Performance Goal 2CK1: Share the experience of expanding the frontiers of air and space with the public and other stakeholders by meeting 4 of the 5 indicators for this goal.

- More Americans can visit a NASA exhibit, through a minimum of 350 events per year.
- Public attendance and participation in the NASA Art Program will increase, through exhibitions in 15 additional states.
- Agency officials and astronauts will convey clear information on NASA activities through the most used media in America: television, through no less than 20 live shots per month on average.
- NASA's activities and achievements will be chronicled and put into perspective for the American public, through 10 new historical publication.
- Documents significant in the Agency's history will be made available to a larger audience by producing one, new electronic document – a CD/ROM.

Objective: Disseminate scientific information generated by NASA programs to our customers.

Public Benefit: The public will have greater access to increased, relevant and understandable scientific information, which will enable them to share in the excitement of discovery.

Annual Performance Goal 2CK2: Inform, provide status, enthuse, and explain results, relevance and benefits of NASA's programs by meeting 2 of the 3 indicators for this goal.

- Effective use of the NASA Home Page to communicate knowledge about NASA's scientific and technological achievements to the public. Effectiveness will be rated by placing at least 50 stories about breaking news on science and technology discoveries.
- The History Office will create one additional on-line exhibit on the NASA History Web page.
- The History Office will meet the need for a timely and effective response to the public by meeting or exceeding 90% of the time a 15-day response standard.

Objective: Transfer NASA technologies and innovations to private industry and the public sector.

Public Benefit: General and targeted members of the public can benefit economically as well as intellectually through clear, effective communications concerning the Agency's activities.

Annual Performance Goal 2CK3: Ensure consistent, high-quality, external communication by meeting 3 of the 4 indicators for this goal.

- Effectively communicate technologies available for commercial use and technologies that have been commercialized by industry, through specific publications. Effectiveness will be measured by monitoring print and electronic distribution.
- Publish at least one industry specific, special edition of *Aerospace Technology Innovation* issue in FY 2002, to attract new readership and encourage partnerships with targeted industry sectors.
- Carry out effective NASA technology transfer market outreach to the medical device industry.
- The *NASA TechTracS* database, accessible through the Internet, will list at least 18,000 NASA technologies that are considered to be of benefit to U.S. industry and the public.

Objective: Support the Nation's education goals.

Public Benefit: The general public will have increased learning opportunities in science and technology fields through NASA sponsored programs.

Annual Performance Goal 2CK4: Using NASA's unique resources (mission, people, and facilities) to support educational excellence for all, NASA supports the Nation's education goals by meeting 3 of the 4 indicators for this performance goal.

- Provide excellent and valuable educational programs and services, maintaining an "excellence" customer service rating ranging between 4.3 and 5.0 (on a 5.0 scale) 90% of the time.
- NASA will involve the educational community in its endeavors, maintaining a level of involvement of approximately 3 million participants which include teachers, faculty, and students.
- Through meaningful partnerships, NASA will increase the amount of total funding obligation from the FY 2000 baseline for Historically Black Colleges and Universities and Other Minority Universities.
- NASA will establish an undergraduate scholarship program beginning in FY 2002.

Verification and Validation

Performance plan goals and indicators are subject to audit by internal and external groups. Thus, there needs to be a set of processes to document the metrics. Due to the broad nature of the Communicate Knowledge crosscutting process, there is a broad array of methods to verify and validate the reported metric data. These methods include the following:

1) Monthly reports from Field Centers.

2) Automatic built in statistics gathering software (web statistics).

3) On-air records & reports from NASA Field Centers television producers.

4) Field Center reports and commercially acquired video monitoring report from Burrelles.

5) Count of publications (History Office).

6) *Innovations* mail list and electronic subscription request file, recorded inventory and distribution request, and monitored Web site hits.

7) EDCATS has a multi-layered process to verify the accuracy and quality of the data collected.

a) Each program manager has access to rollup reports and to raw data, which identify the total number of records, the name of the reporter or participant, and a summary of the data. Thus, duplicate records can be identified, checked, and removed or corrected, or missing data sets can be identified and the reporter notified that they must complete their reports.

b) Each NASA-wide program manager and Center or Enterprise point of contact has access to a report which compiles all the records entered for their area of responsibility, so they can access the status of their specific program records and thus work with the program managers to correct errors or provide for missing reports. These “roll up” reports also provide data at a level of detail which permits the kind of visibility that can highlight implausible numbers so that action can be taken to make corrections where needed.

c) The EDCATS Program Manager has access to all levels of data and checks the status of data at the program level regularly, working with Agency points of contact and/or program managers to ensure the quality of data. The EDCATS software developer also checks the data and informs the EDCATS Program Manager of anomalies or suspected problems.

8) *NASA TechTracS* - The review of new technology reports and authorization for release to the public is carried out by each Center's patent counsel. A set of written procedures for this process is available upon request. The actual implementation of a release is controlled automatically when the "release to public" data field in each Centers' *TechTracS* is set to yes. Access to this data field is tightly controlled by each Center.

9) Metric data is collected by contractor as part of the contract report. Improvements are verified by a NASA representative of the STI Program Office, Principal Center for the STI Program.

10) On-site visits.

11) Counters on the web pages, reports on the numbers of information requests, monthly activity reports, e-mails, memos, letters, press releases, publications, and the NASA History Program Review which takes place each year. There is some limitation to this data in the sense that the web page counters do not document why an individual accesses the web page.

12) Listings of events, activities and products are available on the Internet. The NASA Web site, http://www.nasa.gov/, is updated daily and provides to the general public information about the most interesting information about the Agency. This Web site is the "hub" for the other NASA Web sites and provides links to all other areas of the agency. For example, there is a link to the Space Science Web site, http://spacescience.nasa.gov/, an excellent location updated daily with the latest news, pictures of space, and education activities. In addition to links to the NASA enterprises, the main NASA Web site also contains links to areas such as the education programs, the history office, human resources, research opportunities, and business opportunities. The Education Programs Web site (http://education.nasa.gov/), for example, provides to the visitor user-friendly activity calendars, and educational products and resources. Each field center also offers a central Web site with numerous links to activities, events, and products specific to the area of excellence that distinguishes each Center.

13) Reports from the NASA Centers regarding their imagery additions for the year.

14) Data are collected from participants in Agencywide, Enterprise, and Center education programs via an on-line data collection system. Program participants have the opportunity to rate our programs by answering a series of questions including, would they recommend the program to others; how would they rate the staff; do they expect to apply what was learned; and was the program a valuable experience. The ratings provided on these questions are then used to create an "overall average for excellence."

MULTI-YEAR PERFORMANCE TREND
Communicate Knowledge Crosscutting Process

Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY 1999, 2000, and 2001)/Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY 2002).

	FY 1999	**FY 2000**	**FY 2001**	**FY 2002**
Annual Performance Goal and APG #	CK9: Produce 10 new publications chronicling and placing NASA's activities and achievements in perspective for the American public. Sponsor or co-sponsor one major scholarly conference.	0C3: Produce 12 new historical publications chronicling and placing NASA's activities and achievements in perspective for the American public.	1CK1: Share the experience of expanding the frontiers of air and space with the public and other stakeholders by meeting 5 of the 6 indicators for this target.	2CK1: Share the experience of expanding the frontiers of air and space with the public and other stakeholders by meeting 4 of the 5 indicators for this goal.
Assessment	Blue	Green	TBD	TBD
Annual Performance Goal and APG #	CK10: Acquire 10,550 NASA-sponsored, -funded and/or -generated report documents for the American scientific community and public, publish 26 issues of an electronic current awareness product to announce additions to the NASA STI database, and add 24,400 bibliographic/ citation records to the online NASA STI data base.			
Assessment	Blue			

Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY 1999, 2000, and 2001)/Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY 2002).

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0C12: The Office of Public Affairs is acquiring the capability to provide the media with digital, high-definition video when the broadcasting industry converts to digital broadcasting in the next decade. It will also add a searchable online digital version of the NASA Headquarters photo archive to the NASA Home Page.		
Assessment		Green		
Annual Performance Goal and APG #		0C13: The Office of Public Affairs will open exhibits to new audiences. A series of new exhibits with updated information on the Agency's four Enterprises will begin circulation. New Internet sites to inform the public of exhibits available for loan will expedite the loan process and attract new audiences. Two NASA Centers will create new exhibits and renovate visitor facilities to attract and accommodate additional visitors.	*Captured in APG (1CK1)	*Captured in APG (2CK1)
Assessment		Green		

Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY 1999, 2000, and 2001)/Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY 2002).

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0C19: Maintain a baseline for live satellite interview programs of no less than 10 live shots per month.	*Captured in APG (1CK1)	*Captured in APG (2CK1)
Assessment		Blue		
Annual Performance Goal and APG #		0C20: Maintain a baseline of 5 Video File elements per week, issuing raw video and animation daily on NASA TV.		*Captured in (2CK1)
Assessment		Blue		
Annual Performance Goal and APG #		0C4: Increase the NASA-sponsored, funded, or generated report documents for the scientific community and public from 11,600 to 13,920.	*Captured in APG (1CK1)	*Captured in APG (2CK1)
Assessment		Blue		
Annual Performance Goal and APG #		0C16: Increase the nontraditional NASA-sponsored scientific and technical information through the NASA Image exchange (NIX) digital image database from 300,000 in FY98 to more than 470,000 in FY00.	*Captured in APG (1CK1)	
Assessment		Green		

Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY 1999, 2000, and 2001)/Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY 2002).

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0C14: The History Office will target high school students through the use of a History Day competition on "Science, Technology, and Invention." The contest is being conducted in concert with the History Day Organization, with co-sponsored teacher workshops at every NASA Center.		
Assessment		Red		
Annual Performance Goal and APG #		0C6: The Office of Scientific and Technical Information Program plans to improve the NASA Image exchange (NIX) meat-search engine accessing all NASA digital image databases, adding Quick-Time, video, animation, and browse categories on NASA's key topics of interest to customers.		
Assessment		Green		

Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY 1999, 2000, and 2001)/Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY 2002).

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		Increase the number of searched pages in NASA Web space by 5% per year, relative to the FY99 baseline. (0C17)	Inform, provide status, enthuse, and explain results, relevance and benefits of NASA's programs by meeting 2 of the 3 indicators for this target. (1CK2)	Inform, provide status, enthuse, and explain results, relevance and benefits of NASA's programs by meeting 2 of the 3 indicators for this goal. (2CK2)
Assessment		Blue	TBD	TBD
Annual Performance Goal and APG #		Increase the capacity of the NASA Home Page to meet public demand by providing for a 5% per year increase in download capacity, using FY99 figures as a baseline. (0C18)	*Captured in APG (1CK2)	*Captured in APG (2CK2)
Assessment		Blue		
Annual Performance Goal and APG #		Provide the public with internal access to listings of (1) existing and upcoming communications events, activities, and products and (2) best communications practices within NASA. (0C7)		
Assessment		Red		

Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY 1999, 2000, and 2001)/Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY 2002).

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0C21: Provide publications that will communicate technologies available for commercial use and technologies that have been commercialized by industry to facilitate technology transfer. The three principal publications are *Innovations*, (12,000), *Spin-off* (50,000), and *Tech Briefs* (205,000), whose effectiveness will be measured by monitoring readership and frequency of use as a source of reference.	Ensure consistent, high-quality, external communication by meeting 2 of the 3 indicators for this target. (1CK3)	Ensure consistent, high-quality, external communication by meeting 3 of the 4 indicators for this goal. (2CK3)
Assessment		Green		
Annual Performance Goal and APG #		0C22: Publish at least 1 industry specific *Aerospace Technology Innovation* issue per year.	*Captured in APG (1CK3)	*Captured in APG (2CK3)
Assessment		Blue		

Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY 1999, 2000, and 2001)/Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY 2002).

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		0C15: The Office of Aero-Space Technology's *Aerospace Technology Innovation* Publication will be targeting medical facilities for new readership, as well as the automotive industry for new technology transfer opportunities. The organization will attend the Society for Automotive Engineers annual tradeshow in Detroit, Michigan.		*Captured in APG (2CK3)
Assessment		Red		

Highlight existing and identify new opportunities for NASA's customers, including the public, the academic community, and the Nation's students, to directly participate in space research and discovery.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	CK1: Increase the number of educators who participate annually in NEWEST/NEWMAST) to 500 from 400 in FY 98.			
Assessment	Green			

Highlight existing and identify new opportunities for NASA's customers, including the public, the academic community, and the Nation's students, to directly participate in space research and discovery.

	FY 1999	**FY 2000**	**FY 2001**	**FY 2002**
Annual Performance Goal and APG #	CK2: Increase the number of students reached through the NEWEST/NEWMAST program to 42,000 students from 33,600 in FY 98.			
Assessment	Green			

Highlight existing and identify new opportunities for NASA's customers, including the public, the academic community, and the Nation's students, to directly participate in space research and discovery (FY 1999, 2000, and 2001)/Support the Nation's education goals (FY 2002).

Annual Performance Goal and APG #	CK3: Maintain the participation level in Agency-wide educational programs at more than 1 million teachers and students.	0C1:Seek to maintain a level of participation involvement of approximately 3 million with teachers, faculty, and students in the education community.	1CK4: Use NASA's ability to support meeting the Nation's education goals by meeting 3 of the 4 indicators for this target.	2CK4: Using NASA's unique resources (mission, people, facilities) to support educational excellence for all, NASA supports the Nation's education goals by meeting 3 of the 4 indicators for this performance goal.
Assessment	Blue	Blue	TBD	TBD

Highlight existing and identify new opportunities for NASA's customers, including the public, the academic community, and the Nation's students, to directly participate in space research and discovery (FY 1999, 2000 and 2001)/Transfer NASA technologies and innovations to private industry and the public sector (FY 2002).

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	CK12: Increase new technology opportunities from 19,600 to 19,700. These will be made available to the public through the NASA TechTracs database and will be measured by monitoring a controlled data field that indicates the number of new technologies communicated to the public.	0C9: Increase new opportunities to transfer technology developed at NASA to private industry from 19,600 to 19,800. These opportunities will be made available to the public through the NASA TechTracs database and will be measured by monitoring a controlled data field that indicates the number of new technologies communicated to the public.	*Captured in APG (1CK3)	*Captured in (2CK3)
Assessment	Blue	Green		
Annual Performance Goal and APG #		0C10: Assist customers who use the STI Help Desk and the NASA Image exchange (NIX) digital image database within a specific turnaround period.	*Captured in APG (1CK2)	
Assessment		Green		
Annual Performance Goal and APG #		Support no less than 800 portable exhibit loans and send portable exhibits to a minimum of 175 targeted events per year. (0C11)		
Assessment		Blue		

Communicate Knowledge FY 2002	**Budget Category**	**Space Science ***	**Earth Science ***	**Biological and Physical Research ***	**HEDS ***	**Aero-Space Technology ***	**Academic Programs**	**Research & Program Management**
Annual Performance Goal and APG#								
Share the experience of expanding the frontiers of air and space with the public and other stakeholders by meeting 4 of the 5 indicators for this goal. (2CK1)		x	x	x	x	x		x
Inform, provide status, enthuse, and explain results, relevance and benefits of NASA's programs by meeting 2 of the 3 indicators for this goal. (2CK2)		x	x	x	x	x		x
Ensure consistent, high-quality, external communication by meeting 3 of the 4 indicators for this goal. (2CK3)						x		
Using NASA's unique resources (mission, people, and facilities) to support educational excellence for all, NASA supports the Nation's education goals by meeting 3 of the 4 indicators for this performance goal. (2CK4)		x	x	x	x	x	x	

* The Enterprises also have specific APGs and indicators dealing with Communicating Knowledge.